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PHYSICAL THEORY.

We reprint, on another page of this issue, a valuable discussion of a recent paper by Dr. J. J. Thomson, by one who signs himself "W. S. F.," but whose identity might easily be guessed. This discussion points out clearly the weak points, as well as the strong, of a most important contribution to physical theory. The sciences of physics and chemistry used to be classified, the one as the study of energy; the other, as the study of matter. But the physicist is not content in his own field: he is looking for a fundamental theory which will apply to chemistry as well as physics. Of late he has been playing havoc—in his own opinion, at least—with the atom, and he thinks he now can give physical explanations for chemical facts. As our knowledge increases, men find it necessary to specialize, following widely differing branches, but their work only draws the various branches of the science—as they now are—closer together. After all, there is only one science, that of nature, and our classification is merely a convenient way of arranging our hardly acquired knowledge.

ELECTRICAL OSCILLATIONS.

The subject of resonance in an electric circuit is shrouded in mystery to the practical, or rather, let us say, non-mathematical man. It is hard enough to understand the action of a condenser or of an inductive coil in resisting the flow of an electric current, even when either is taken alone. Then, when one has been fully impressed with the importance of these devices in opposing the flow of current, he is told that if he places both in a circuit at the same time, and proportions them properly, each will neutralize the effect of the other, and the value of the current flowing will depend only upon the resistance of the circuit. To accept this plain statement when it is first made tries one's faith considerably, and to the greater number of students a mathematical proof, while it can not be questioned, is not altogether convincing, since to them it means little more than a juggling with symbols. Actual experiments, however, soon persuade one of the truth of the mathematical deductions, but his ideas of the physical actions going on are apt to be hazy for some time.

It does not seem very difficult to get a fairly clear idea of what is happening in a resonant circuit, if only the problem is approached in the proper way. A condenser is a device which will store up electrical energy when connected to a battery or any source of electric energy. If the terminals of the condenser are then connected together by some conducting material, the condenser discharges, a current flowing along the path provided, and the energy stored up is dissipated as heat or otherwise, due to the resistance of the path. An inductive coil is merely a winding which may set up a magnetic field when a current passes through it. Faraday showed that a variation in the magnetic field surrounding a conductor sets up an electromotive force in that conductor. If, then, the electric current passing through our coil vary, the magnetic field which it sets up must vary with it, and this variation of the magnetic field, according to Faraday's law, reacts upon the current flowing, and always in such a way as to oppose the change in the current. If the current be increasing, the reaction—or, as we call it, the inductive electromotive force—opposes the increase; if the current be decreasing, it opposes the decrease. In other words, it retards the growth and retards the decay of a varying current.

Suppose, now, we attempt to discharge our charged condenser through our inductive coil, the resistance of the circuit being negligible, as soon as the circuit is completed, a current will begin to flow, increasing in value from zero to a maximum. This increasing current sets up a magnetic field, which grows with the current, and which reacts against the current. The reaction against the current depends upon the rate of change of the magnetic field, and not upon its strength; and

the rate of change is a maximum when the current first begins to flow, and a minimum when the current reaches its maximum value. The result is that the maximum value of the current is reached at the moment the condenser is completely discharged. But at this moment the field surrounding the coil is a maximum. Assuming no energy losses in our circuit, all the energy which was first stored up in the condenser is now stored up around the coil in the magnetic field. At this moment there is in our circuit no force tending to keep the current flowing, and it would at once die out, were it not for the fact that any decrease in its value is opposed by a corresponding change in the magnetic field surrounding the coil. The current will therefore continue to flow in the same direction, and will die out gradually; but since the condenser was completely discharged at the moment the current reached its maximum value, this prolongation charges the condenser in the opposite sense, the current continuing to flow until the magnetic field surrounding the coil has completely disappeared. The energy recently stored in the field around the coil is again transferred to the condenser—though the direction of charge is reversed—and the conditions are ready for a new discharge. This process would keep up indefinitely, were it not for losses, which can not be avoided, in the circuit. All of the electrical energy which was originally stored up in the condenser is finally converted into heat.

This discharge and recharge of the condenser takes place at a definite rate, depending upon the size of the condenser and the winding of the coil. In other words, the process is periodic. But suppose that we introduce into our circuit an electromotive force which has a period exactly equal to the natural period of the circuit. The condenser is charged and discharges itself as just described. In this it is assisted by the alternating electromotive force, which also acts with the coil in charging the condenser in the opposite direction. The intensity of the current which will flow in this case will depend only upon the resistance of the circuit, since, as the condenser is being charged, its opposition to the flow of current into it is balanced by the effect of the coil; and, on the other hand, the resistance offered by the coil to an increase in the current is offset by the effect of the discharging condenser. This is the condition known as resonance, and when it occurs an enormous current may be set pulsating in the circuit, although but little power is required to drive the dynamo which furnishes the alternating electromotive force.

In practice, the disadvantages of such a condition are several: This large current causes a large armature reaction in the generator, and this affects adversely the regulation. It also causes a considerable loss in the conducting wires. But the most serious objection is due to the rise of potential which takes place at the condenser and at the inductive winding. The potential at the terminals of a condenser is equal to the quantity of electricity with which it is charged, divided by its capacity, and since in a resonant circuit the quantity may be great and the capacity small, the potential may be high—in fact, possibly many times that of the generator. The same is true for the coil, and these rises of potential, when not provided for, may produce disastrous effects by breaking down the insulation of the system. Resonance may occur not only when the fundamental frequency of the generator is equal to or approaches the normal period of the circuit, but it may be caused by harmonics in the electromotive-force wave. The occurrence of such a condition in practice is probably rare, but the possibility should not be overlooked, and in important installations the distributing systems should always be analyzed with a view to determining what probability there may be of such a condition arising.

PREVENTING DISASTERS.

When a city is visited by such a lamentable disaster as that which befell New York recently, there is great activity displayed all over the country in investigating the similar hazards, and in taking precautions against any like mishap. We have been taught a lesson, yet such is our short-sightedness that we seldom grasp the full significance of the warning. After the Iroquois theatre in Chicago was destroyed, with such awful loss of life, everywhere theatres were promptly put in a safer condition than ever before, but no one thought of the danger of a crowded ill-equipped excursion boat. Now that the unexpected has happened in New York, the excursion boats are being overhauled, and doubtless they will be comparatively safe in the future. If we are wise, however, we will take warning from this last disaster, and not be content with making our excursion boats safe, but look around for other possible dangers and take means to prevent them. Every place where a crowd may gather should be investigated, not only to determine the risk of fire, but to see what other danger may lurk there; and no place of recreation and no system of transportation, no place or thing to which a crowd, whether large or small, may be drawn, should be allowed to go uninspected. Not until this is done can we hope to avoid such misfortunes as seem to have been our lot, both in unusual number and severity, within the past twelve months.

A LOADED TELEPHONE TRANSMITTER.

There is to-day a wiser telephone subscriber in the neighborhood of Getaway, W. Va., if one may credit the story told by a local newspaper. Finding some difficulty with his telephone, this self-appointed repair man undertook to put it in order, but not with entire success, for upon taking apart the transmitter, the granulated carbon was spilled upon the floor and some lost. An examination of what was left convinced the would-be expert that the grains were nothing more than gunpowder. Consequently, when putting the instrument together again, he used gunpowder to replace the lost material. After finishing the job to his satisfaction, he attempted to call up the exchange, so that he might ascertain how successful his work had been, not thinking that now his transmitter was loaded; but, upon ringing the magneto, the gunpowder in the transmitter exploded, with some damage to the subscriber's face, and disastrous effects upon the telephone. A moral and a caution may be drawn from this little incident. Do not meddle with your electrical appliances unless you happen to know something about each particular device. A dynamo tender is apt to make as poor a repair job of a telephone as the farmer referred to above. And do not take too literally the words used by the electrical fraternity. A loaded telephone line is not loaded with gunpowder.

HIGH-TENSION TRANSMISSION MEETING AT CHICAGO.

A SPECIAL MEETING OF THE INSTITUTE FOR THE DISCUSSION OF SEVERAL VALUABLE PAPERS.

A special meeting of the American Institute of Electrical Engineers was held at the assembly rooms of the Western Society of Engineers, Monadnock Block, Chicago, Ill., June 21 and 22, 1904. President B. J. Arnold called the meeting to order on Tuesday morning. It was gratifying, he said, to find so many members present. Announcement was made by Secretary Ralph W. Pope concerning the papers and the questions and answers relative to the meeting.

Without any further preliminary, President Arnold called for the first paper on the programme, entitled "Line Construction with Steel Supporting Structures and Long Spans." This was read by the author, Mr. F. O. Blackwell, of New York. In order to utilize time to the best advantage, the president called for the next paper, "Protection of Cables from Arcs Due to Failure of Adjacent Cables," by Mr. W. G. Carlton, of Chicago, Ill. After the reading of this paper the discussion became general.

Mr. Ralph D. Mershon, in speaking of a steel tower acting as a lightning arrester, cited an instance where iron rods had been installed attached to the tower and bent up around the insulator. His experience with line troubles had been that he had fewer accidents from insulators than any other thing. He spoke of malicious interference with transmission lines, and suggested that this was, in many cases, from thoughtlessness, and that where the troublesome element was approached in the proper way the remedy was easily applied. Another point which he thought had considerable weight in connection with the transmission line was the question of the formation of sleet. He would like to see a good deal of information concerning this brought out in the discussion. On the question of protecting cables, he preferred tile or brick protection as against wrapping with asbestos.

Mr. F. O. Blackwell made a statement concerning the life of poles, saying that in Mexico a wooden pole would last about two years. It would either be eaten by the ants or would rot out, while in the northern climate it would last probably twenty years. Regarding the elastic limit of materials used for conductors, he had made a number of experiments and found that the conductors took a set any way they were strained. It made no difference how low the pressure was, or how high; any pressure gave the conductors a certain set, and it was a question of how quickly the curve was taken.

Concerning the protection of cables with clay tile, Mr. Wells stated that his company put in four lines following different routes to the substation. Each substation has an entirely different route from the main station, so that in case of a manhole caving in or any trouble on the line, there is only one-quarter of the general cable to become ineffective. Regarding trouble by burning out of the high-pressure cable, some of this trouble had been caused by defective joints, and some of it was due to short bends where the cable leaves the duct. In order to obviate this the cable was carried straight from the duct before making a bend over to the side of the manhole. The use of asbestos wrapping, he said, had worked very well. In station work the company endeavored, however, to use clay ducts wherever possible. He had not found any trouble due to the cable heating because of the asbestos wrapping.

In answer to a number of questions, Mr. Carlton said that the method of separating the conduit lines took into consideration several factors. One of the most important in making a larger conduit was the cost of repaving the street. With regard to taking care of the cable on the inside of the power-house, this was one of the most important places to look after, and it was the hardest place for which to afford adequate protection. A three-conductor cable has to have some sort of a bell filled with an insulating compound.

Replying to a question by Mr. Mershon, with regard to the use of a voltmeter, he said that his company has used a metal voltmeter with a five-volt scale. This has a disadvantage, in that it was not possible to tell the direction of the current flow. His company had been trying to get a voltmeter with a zero line in the middle, which would give readings above and below. He said the voltmeter was connected between the lead sheath of the cable and a good ground. In the stations connection was made with the ground plate; in a manhole the meter would be connected to a water pipe or sometimes to the cast-iron frame of the manhole.

Mr. Charles F. Scott sketched the evolution of line construction from the early telegraph conditions. He said that before much progress was made the building of a transmission line became a mechanical engineering problem, rather than an electrical one. He was particularly interested in the type of conductor and the differences between copper, aluminum and iron. He would like to see as much data as possible brought out in connection with the use of aluminum as a conductor.

With regard to the use of pipe towers, Mr. Blackwell stated that in tropical countries difficulty had been had with the wooden tower. The trouble was less with the pipe towers. The wooden pole is a better insulator than the iron one, but if lightning strikes it the wooden pole is likely to be shattered. With the iron pole the trouble is lessened.

In reply to a question by Mr. Neal, as to the effect of a lightning stroke on a steel tower, Mr. Blackwell said that nothing had happened in his experience, except that the insulators had been damaged.

Mr. Freeman questioned Mr. Blackwell as to the mechanical breakage of wire, due to imperfection. Those in connection with aluminum wire were very noticeable, and he wished to know whether the sway of the wires would have a tendency to uniformly break at the point of insulation.

Mr. Blackwell replied that the use of cable in place of solid wire would eliminate breakage to a great extent. The whole cable does not break down. The strand frays out a little, and this may be noticed and repaired readily.

Mr. M. Hoopes took up the question of the comparison of aluminum and copper. He described a transmission line which had four spans of aluminum wire a thousand feet long. In connection with the calculation for wind strains on a line of this description, it was his opinion that the only thing that could be done would be to estimate a maximum, and construct to that limit. The real safety is the ratio between the elongation under assumed conditions and the elongation the wire will stand.

Mr. Mershon called attention to the answers to the questions which had been sent out by the committee, and which constituted its report. He desired the members to familiarize themselves with the scope of these questions and answers, and enter into the general discussion which would follow. The session then adjourned for luncheon.

The afternoon session was called to order promptly at 2.30 P. M. The first paper taken up was by Mr. M. H. Gerry, Jr., on "The Conditions for Continuous Service Over Lines Operated in Parallel." This was followed by the reading of a paper on "The Use of Ground Shields in Transformers," by Mr. John S. Peck, of Pittsburg.

Mr. Mershon opened the discussion on Mr. Gerry's paper. He said that it did not seem to him safe to install a high-voltage transmission system in a city without either ground shields or grounding the neutral of the lower-voltage windings.

Mr. H. C. Wirt, of Schenectady, N. Y., said that he did not think anybody was seriously considering the use of the ground shield. With regard to the grounding of the neutral, it seemed to him that it was emphasized more than it deserved. In connection with the danger of grounding the neutral, he thought this was considerable. In investigating some recent trouble, he found a grounded neutral at some distance from the point of breakdown in a gas pipe. When the gas pipe broke down a fire was started, which might have caused considerable danger.

Referring to the question of steel poles for transmission lines, President Arnold said that the New York Central had investigated the question thoroughly. The argument in favor of steel poles for long-

distance transmission, running across the country, where the poles can be spread far apart, is good, but in the city the poles must be placed closer together, and a great number of steel poles can not be procured as cheaply as wooden poles. He thought that very often the question was made one of the relative cost of wood *versus* steel. It was not a question of steel poles being desirable, but whether they could be procured reasonably. With regard to the comparative stability of overhead and underground construction, he said that the evidence appeared to show that there is less trouble with overhead transmission lines in the country than with underground cable.

Mr. Charles F. Scott said that it was not a question of cost which should determine the use of material for a transmission line: it was a question of better service, a different order of construction. In any case the first consideration should be the general engineering condition, and then what would give the most reliable service. Additional costs—if there should be an additional cost—should be considered after.

Concerning the question of the size of the wire to be used in transmission systems, Dr. F. A. C. Perrine said that the solution of the transmission problem was a question of reliability, and not one of cost. He thought the average for this country was about 1,000 volts per mile, and for ten or fifteen miles a good deal of current could be transmitted over a comparatively small wire. Until 30,000 or 40,000 volts was reached there was no necessity to limit the size of the wire by the voltage. At from 40,000 to 60,000 volts the wires must be limited to not less than three-eighths of an inch, or for wires smaller than three-eighths of an inch the discharge into the air from the wire, for a reasonable distance separation, is so great that the transmission must necessarily be ineffective. There is a reason for using aluminum for long lines: the size of aluminum wire is advantageous, because the surface tension in aluminum wire is less, and, in consequence, the builder is not limited to an uneconomical wire for a small amount of energy. Aluminum wire three-eighths of an inch in diameter will dissipate as little energy as copper wire. A smaller amount of energy can be carried more economically with aluminum than with copper. Dr. Perrine further said that an important consideration was the failure of insulators. The insulator is perhaps the worst member of a transmission system, and the fewer there are, the better. This would tend to lengthen the spans, and the lengthening of spans with wooden-pole construction is hardly possible. The long span of the iron-tower construction materially lessens the number of insulators, which, again, allows the use of heavier and larger insulators; and the steel construction allows these to be supported. He believed in long-distance lines, and thought that in a few years insulators would be in use weighing as much as 100 pounds, and that by cutting out the intermediate insulators, with spans of from 100 to 150 feet, constructors could afford to buy the more expensive insulators. The question of the value of the tower as a lightning arrester is important. The value of a grounded barbed or naked wire as protection of a long-distance transmission line against lightning disturbances he thought was unquestioned.

Mr. Mershon did not agree with Dr. Perrine with regard to the protection which a steel tower afforded the line. He did not see how the steel tower could be the equivalent in protection of a static discharge. While the tower might take the discharge which happened near it, instead of going on the line, it did not seem to him that it would be a protection from the current that did get into the line and tried to go over it. It would more likely shatter the insulator. When lightning struck the line it was not simply a case of flashing over the insulator, but there was a puncture, and the insulators go all to pieces.

Mr. W. E. Jackson agreed with the statement that the iron tower would seem to be an excellent protection against lightning. He could not agree with Mr. Mershon that the lightning, in jumping the insulators, as a rule broke them.

Replying to a statement by Mr. Junkersfeld, that an 11,000-volt service would be more reliable with underground construction, President Arnold said that the difference in the relative cost of overhead and underground construction was very great. He did not feel at liberty to say exactly how much, but it was so much that it was decided not to use the underground when the figures were turned in. Approximately, it is seven or eight times as much for underground construction. With regard to reliability, he said that his company was going to put two circuits on the central pole line, each circuit capable of carrying the full load. The total amount of copper installed would be sufficient for a maximum full load.

Dr. Perrine sketched a proposed construction for a 320-mile line, 60,000 volts, 25,000 kilowatts. He found that a fourteen-inch by fourteen-inch insulator was small enough for 60,000 volts. Whether any reasonable size of insulator could be made for 80,000 volts he did not know. Furthermore, he found that with a duplicate three-phase line, if one line was out of service for repair, the regulation would be so bad with a single line in service that it could not be maintained—that is, if one line was perfect, and the other shut down, that there would be no use in trying to get along with half the copper; the regulation would be too bad. Consequently, a system was proposed, of a tower with a house about six feet square, with four wires. The house was constructed of iron. Each compartment was five feet square and ten feet long. The idea was to put the insulators in an enclosed house. There would be four wires all told, and three wires would be in service at one time, one wire being shut down for cleaning the insulator and for repair. In this way enough metal could be concentrated for the three wires that good regulation could be secured. In addition to that, the tower was provided every ten miles with a switch station, so that the service of any one wire could be switched on to any of the four within a section of ten miles. This system has never been built. Two hundred and ninety-six miles is the limit, as far as he knew. But with regard to the proposed tower house, the West Kootenay Power and Light Company, in British Columbia, has a similar construction. It has not found any great advantage from the pent-house. This is largely due to the fact that, while the pent-house protects the insulators against direct rain or snow, the dust can come in continually, and the fog which they have there at times makes mud out of the dust, and this is one of the worst conditions that can obtain. The insulator is best in dry weather and worst after a period of dry weather; consequently, to keep the insulator clean it has got to be cleaned frequently.

Mr. Wirt did not believe in laboratory tests for information regarding lightning. He thought that to get proper ideas concerning this, the information would have to be secured right at the lines.

At this point President Arnold called attention to the fact that the discussion had practically worked around the subjected treated of in Mr. Wirt's paper, and he therefore called upon him to read the paper, which was entitled "The Protection of High-Voltage Transmission Lines from Static Discharges."

Mr. Peck, in opening the discussion on Mr. Wirt's paper, said that he has found, in testing different arresters, that very often when an arrester broke down at 2,000 volts, the pressure would gradually rise, and when a condenser was suddenly discharged through that arrester, it might require a pressure of 10,000 or 15,000 volts. If a shunt gap is placed in conjunction with the arrester, and the discharge made as before, it will be found that the shunt gap will have to be increased to a value very much higher than the actual gap in the arrester itself. This was true of non-inductive arresters, as far as he had been able to determine.

The discussion of Mr. Wirt's paper was continued for some time, when adjournment was made until Wednesday morning.

At ten o'clock Wednesday morning the meeting was called to order, and a paper by Mr. B. G. Lamme, of Pittsburg, Pa., on "Synchronous Motors for the Regulation of Power-Factor and Line Voltage," was read.

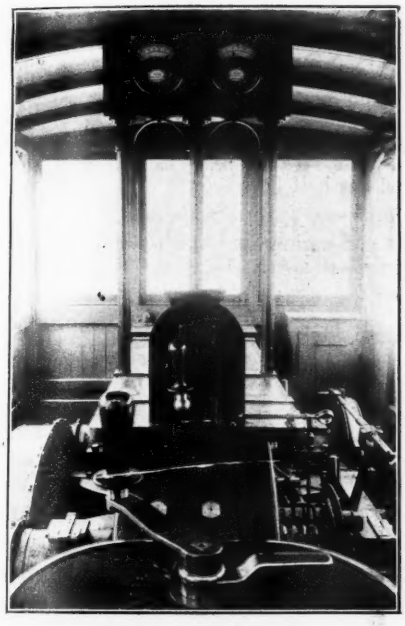
The report of the transmission committee on data collected was taken up and discussed, and this was followed by general discussion on the various topics presented at the meeting.

The electrical interests of Chicago provided an elaborate entertainment for the visitors, and in point of work covered and importance, this meeting is probably one of the most valuable that the Institute has ever held.

The Vesuvius Electric Railway.

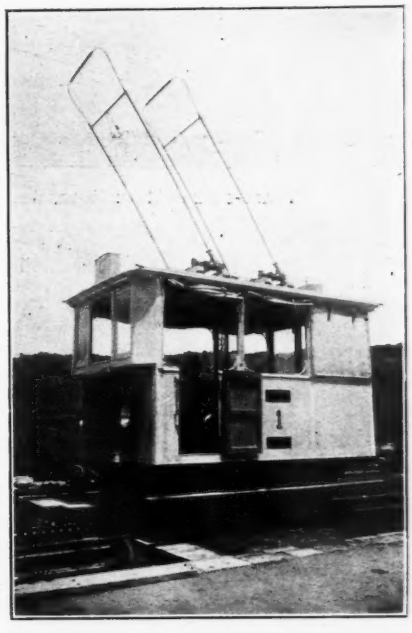
By Franz Koester.

ABOUT twenty-five years ago a cable road was built leading up to the crater of Mount Vesuvius. In 1887 this road was purchased by the firm of Cook & Son, of London, tourist agents, who have greatly improved the road and have recently built an electric road leading from Resina, at the foot of the mountain, about six miles from the city of Naples, up to the beginning of the cable road. The length of the electric portion of the road is 7.5 kilometres (4.56 miles) and it is divided in three sections. The first section, which is 1.9 miles in length, is an adhesion road, and leads from the town up to the power-house and car sheds, where it joins the second section, which



INTERIOR OF THE RACK LOCOMOTIVE, VESUVIAN ELECTRIC RAILROAD.

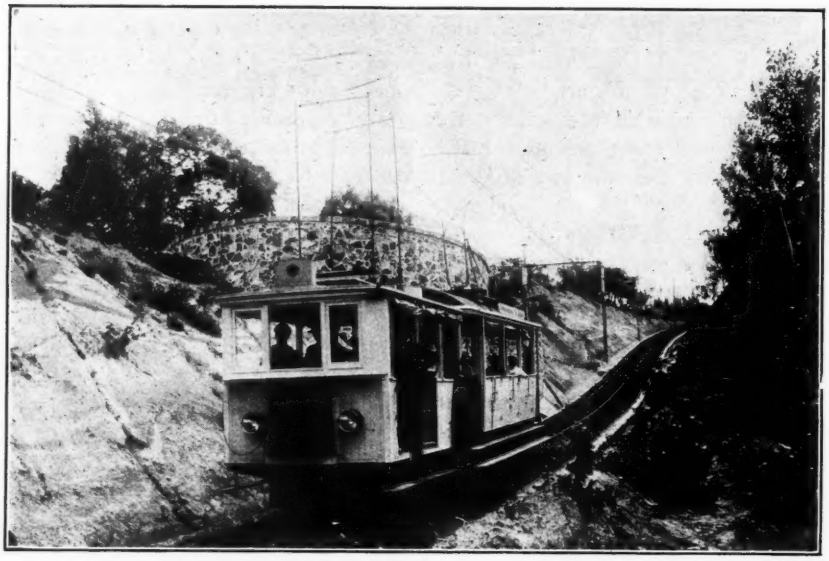
is 1.03 miles long and of rack and pinion construction. This section leads to the Mount Vesuvius observatory, which is 1,848 feet above the sea level; from here the third section, which is an adhesion road, leads to the lowest station of the cable road, a distance of 1.63 miles, the elevation being 794 metres (2,605.3 feet) above sea level. From here the cable road runs in a straight line up the steep side of the lava deposit to a point 3,887 feet above the sea level and 328 feet below the old crater of the volcano. The grade on the cable road varies from thirty-eight per cent to sixty-three per cent, with an average of fifty-four per cent. This cable portion of the road rises one-third of the difference in elevation between Naples and the crater. The electric road is laid with T-rails ten centimetres high and weighing twenty kilogrammes per metre; the ties are of oak. The T-rails are 10.5 metres long and the rack rails are 3.5 metres in length; all rails are set on iron plates and are screwed to the ties. Although in a great many mountain roads on the Continent iron ties are used, yet in this case wooden ties are employed, being much easier to renew in case of damage from molten lava. The gauge is one metre and the rack is placed in the centre between the rails. The rack is of the "Strub" system, patented by the celebrated mountain engineer who has constructed many of the most important roads of this type in the eastern hemisphere. The ties are spaced on one metre centres and all joints in the rails and rack are suspended. The rail joints are of the Brown-Boveri system, the top and bottom of the fish-plates being made to fit snugly against the head and flange of the rail, the abutting surfaces are polished and a metallic paste inserted between them, which serves to prevent rust and also acts as an electrical bond. The cars are provided with sliding bow trolleys and have a capacity of thirty passengers each. On the rack portion of the road the cars are hauled by a specially constructed electric locomotive of the rack and pinion type, and a headway of thirty-five minutes may be maintained. The descending cars are arranged to return current to the line. The entire electrical equipment was furnished by Brown, Boveri & Company. The cars are equipped with single trucks and weigh 8.4 tons. They are two and one-half metres wide and are divided into three compartments, each accommodating eight passengers, six additional passengers can stand on the platforms. The grade on the adhesion portion of the road being eight per cent, the cars are equipped with eight heavily constructed brake shoes and four sand-boxes, two of which are controlled from each platform. In addition, an electrical short-circuit brake operating in connection with an electromagnetic rail brake is provided. The controller is furnished with seven contacts. The handle being moved to the first contact, the motor circuit is broken and it operates as a generator, tending to stop the car and at the same time furnishing current, which is taken up partly by rheostats and partly through the magnet windings of the magnetic brake. Contacts 2, 3 and 4 act in a similar manner to contact 1, more current being sent through the magnetic brake as the controller is moved over, so that when it is on contact 4 the motors are almost short-circuited through the magnet. Contacts 5 and 6 are vacant and contact seven serves to furnish current direct from the line to the magnetic brake. A differential rheostat is provided by means of which, when the motors are employed for braking, the magnetic brake may be cut out entirely and the current absorbed by the rheostat. The hand brakes have a braking power of 1,290 kilogrammes, which is sufficient to hold a loaded car weighing



RACK LOCOMOTIVE ON THE VESUVIAN ELECTRIC RAILROAD.

10.5 tons at a speed of 11.3 kilometres per hour on an eight per cent grade, and by applying the motors and electric brakes the car can be brought to a standstill in nine metres (29.5 feet), provided that it does not slide on the rails. The magnetic brake has a braking power of 4,000 kilogrammes, and with a coefficient of friction of 0.2 can stop the car unaided in fifty-nine metres (193.5 feet). By using the braking power of the motors in connection with the magnetic brake the car can be stopped inside of fifty-nine feet. On the rack railroad the engine and car are coupled together, the train being controlled from the engine, which is equipped with four special independent brakes, any one of which is capable of

stopping the car in a short distance. With the Strub rack system it is not necessary to provide the engine with safety clutches. On the ascending trip the motorman on the front of the car may at any time operate the brake on the locomotive, should the necessity arise for a sudden stop, and he can also signal the engineer when it is desirable.



TRAIN ON THE RACK ROAD, SHOWING ALSO THE COLLECTING BASIN.

The motors are of the usual series railway type and are enclosed in dust and waterproof steel cases. They are strongly constructed, and are guaranteed to have a heating effect not exceeding seventy-five degrees centigrade above the temperature of the atmosphere. The magnetic brake consists of eight magnets, each of which is provided with a pole-shoe at its lower extremity. The adjacent magnets are of different polarity, thus furnishing seven separate magnetic circuits which are completed through the rails. When the current is flowing through the magnets the shoes are drawn down toward the rail, and when the circuit is open they are held about one inch above the rail by means of springs. The braking apparatus slides in vertical guides.

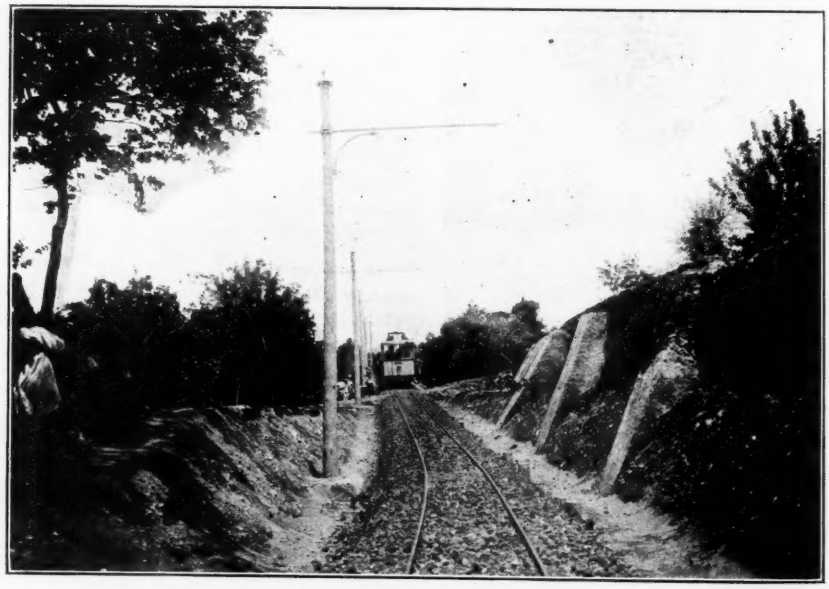
The rack locomotive weighs 10.4 tons, and can pull a load of eleven tons on a twenty-five per cent grade at a speed of from seven to eight kilometres per hour. The locomotives are equipped with two eighty-horse-power, shunt-wound motors which run at a speed of from 650 to 700 revolutions per minute, and are both connected to the pinion by means of gearing. The locomotive is equipped with two double hand brakes, one of which acts on the pinion shaft and also on the emergency brake, the other brake acts on both motor and pinion shafts. In addition, there is an automatic device which operates when the speed exceeds a predetermined limit, by throwing on the brakes and cutting off the current from the line.

The motive power employed for the power plant consists of gas, which is furnished by two gas generators in the power-house. The ultimate capacity of the engine room is for three units each, consisting of a 100-horse-power gas engine, belt-connected to a direct-current generator, which runs at a speed of 700 revolutions per minute and furnishes current at 550 volts. Two of these units are installed at present and a third is to be added in the near future. The gas from the generators is led outside of the building to a gas-holder, from which it is piped to the engines. The engines are of the four-cycle type, the diameter of the cylinder being 520 millimetres and the length of stroke 760 millimetres. A storage battery consisting of 285 elements, having a capacity of 256 ampere-hours, is provided and may be used in parallel with the generators. The generators are shunt-wound, and although they normally furnish current at 550 volts, yet they are so designed that without change in speed the voltage can be raised to 770 volts and the batteries charged while current is being furnished to the line.

The gas generators are placed in a separate room, in which are located two boilers, each having about forty-five square feet of heating surface, which furnish the steam for the gas generators. One of these boilers is sufficient for the present output, the steam being furnished at a pressure of five atmospheres.

At one side of the engine room is a small pump-house, in which are placed a centrifugal pump, a piston pump and an air compressor, which are operated by a four and one-half horse-power motor. The air compressor furnishes the air for starting the gas engines and also for cooling them and purifying the gas.

Owing to the fact that there is no well supply of water at hand the plant is dependent for its supply upon rain water. This is collected in a reservoir built 32.8 feet above the plant, where it is allowed to settle; from here it is led to an adjoining basin of the same capacity, this latter being connected to the power plant by means of two pipes. One of these pipes leads to a



TROLLEY CAR ON VESUVIAN ELECTRIC RAILROAD, EIGHT PER CENT GRADE.

reservoir built under the car barn, which is a part of the power-house; this reservoir has a capacity of 35,000 cubic feet. The other pipe leads to the gas generators and furnishes them with the necessary water. The centrifugal pump in the pump-house draws water from the basin under the car barn and furnishes the cooling water for the gas engines, the piston pump at present being held in reserve.

The trolley wire is eight millimetres in diameter, two wires being used on the rack portion of the road and one wire on the other portions. Two wires are used on the rack part of the road in order to reduce the line losses, as it is on this part of the system that comes the greatest demand for current. The standard poles are of wood, equipped with iron brackets, the trolley wire being supported by span wires insulated from the brackets by porcelain insulators. Where occasion demands it, lattice poles are used, and in some instances the double-pole construction, one on either side of the track, is employed. Where the line is exposed to danger from lava a cheap pole is employed. The line is divided into two main sections at the power plant, the upper section being again divided at the observatory in order to cut off that portion of the road which is subjected to the greatest danger from the lava.

The entire line is provided with lightning arresters placed on the poles, located one kilometre (3,280 feet) apart, the arresters being connected to the rails. Provision is made for taking up the expansion in the line for every 1,640 feet in length. The voltage drop in both the single and double trolley lines reaches a maximum of twenty-five per cent.

The cost of the entire installation, including power plant, right of way, rolling stock and equipment, was $230,800, making a cost of about $52,800 per mile.

The old cable road leading to the crater was subject to continual deposits of lava, and in time a gully was formed about six and a half feet deep, in the centre of which was the roadbed. Recently this gully has been filled with stone, a solid roadbed obtained and the track raised about ten feet. New rails were provided, the old rails being used as ties. At intervals of sixty-five feet these ties are anchored in concrete built on the rock of the roadbed. Along the side of the entire cable road has been built a stepped pathway for the track inspectors.

In addition to these improvements new rolling stock has been added to meet the growing demands of the traffic, and the cable power plant has also been renovated. These improvements to the cable road were made at a cost of $32,000, or about one-third of the cost of the old cable road. The trip over the electrical portion of the road occupies forty-eight minutes, the fare for the round trip from Naples to the crater being $4.20. This high charge is due to the heavy maintenance expenses which must be met.

ELECTRICAL MINING NOTES.

THE MEETING OF THE INSTITUTE OF MINING ENGINEERS.

BY SYDNEY F. WALKER.

The recent meeting of the Mining Institute might fairly be described as largely an electrical session. There were three papers on electricity before the meeting and they occupied all that was left of the first day after the reading of the president's address. The first was by the writer, on the report of the departmental committee of the Home Office on the use of electricity in coal mines. This paper took up in condensed form the above-named rules, as fault had been found because of their great length. In preparing abbreviated rules, the writer endeavored to put into them what it appeared was in the minds of the committee, as shown by their report, and by the rules themselves. The shortened rules follow:

1. Pressures of 3,000 volts were not to be used, nor pressures of 650 volts outside the main intake airways, or chambers directly supplied from them.

2. All metals enclosing or protecting any portion of the conductive system to be connected to earth.

3. No part of the conductive system to be connected to earth.

These three rules to be subject to exemption by H. M. inspector for the district.

4. All apparatus to be so fixed that no overheating could take place, no arc could persist and no shock be obtained in the ordinary course of work.

5. All cables, machines, etc., to be tested periodically for insulation, the tests to be recorded in a book provided for the purpose and leakage not to exceed one ten-thousandth of current.

6. All connections between cables and generators, motors, lamps, etc., to be properly controlled.

Considerable discussion followed.

The mining men, other than the inspectors, were almost to a man against the rules, and they were against placing any further power in the hands of the inspectors.

The question of earth caused considerable discussion. The writer had condemned the committee's rule in his paper, in which cables carrying currents at more than 650 volts pressure are to be enclosed in armor, or in iron pipes, and the armor or the pipes earthed. In some districts of South Wales, one speaker stated, earth could not be obtained without considerable trouble and expense; while in other places it would be impossible to depend upon armoring, as it would be eaten away so rapidly.

It was also recommended that there should be an electrical engineer at each colliery, who should hold a similar position to that held by the mechanical engineer that is carried by all collieries; that the electrical engineer should be supreme within his own department, subject to the colliery manager and H. M. inspector.

The second paper was by the engineer of a Yorkshire colliery, who has had full opportunity of testing pretty well every kind of electrical apparatus at his colliery, and was on the question of three-phase current versus continuous for mining work. The author was of the opinion that three-phase was best for mining work, principally on account of the absence of commutators, and the greater general simplicity. He had succeeded in adapting three-phase motors to every kind of machine about a colliery, including coal cutting. His opinion was not allowed to go unchallenged. It was pointed out that three-phase motors ran with very small clearance, and that this had led to troublesome stoppages, from the rotor binding on the stator, and it was often difficult to discover the cause, as it disappeared, in some cases, immediately the current was turned off. It was also pointed out that the question of the maintenance of a constant pressure was a troublesome one, unless the generator was well above its work; the starting currents taken by the motors lowering the pressure very considerably. The question of fuses came up for discussion in this paper. The author of the paper stated that he had banished fuses altogether from the face of the coal and its neighborhood, as he found that in the case of a motor driving a coal-cutting machine, which is perhaps the most severe case, if the cutter sticks, and the motor stops, the attendant has plenty of time to get to the switch and cut off the current, the induction of the rotor coils upon the stator coils having the useful effect of choking back the supply current for a time at any rate. In the discussion it was also pointed out that a three-phase induction motor had a great advantage over a continuous-current motor in cases where the motor was called upon to deal with a heavy load, or was brought to rest with the continuous current, the armature coils received an enormous excess of current, and their insulation, which forms a small part of the total substance, became charred, and was quickly displaced when the machine started again—if it had not been before. But the insulation of the

stationary coils of the stator might be heated very considerably, and might even be badly charred, yet the machine would go on working for some time, as the charred cotton itself is a fine insulator, so long as it is not disturbed.

The third paper came from America, and instituted a comparison between the compressed air and electric locomotives for mining work. Locomotives are not used at all underground in England, the roads in the collieries, which are now working the deep seams, being very steep, so that the matter is hardly of much importance on this side.

The question of compressing air by electric motors in the mine was raised. This has been done in Germany for some time. It was stated that the first cost of coal cutting on these lines was practically twice that with electricity pure and simple. There was another paper, on the following day, in which electricity was concerned. The author described an apparatus which he had worked out for greater safety in winding, the engine being automatically stopped in case of accident. The author is a mechanical engineer, and as long as he kept to mechanical methods he was fairly safe, though the apparatus had only been tried on a small scale, and some of the mining engineers present expressed grave doubts about its adaptability if it was applied to the fast winding of some of the modern pits. The author had worked out a very ingenious arrangement of electrical control worked by the cage itself.

Purdue University.

At the thirteenth annual commencement of Purdue University, La Fayette, Ind., June 8, 1904, degrees were conferred upon 187 graduates. Advanced degrees were conferred on twelve candidates, and the degree of doctor of engineering upon Elwood Mead, of the class of 1882, now chief of the bureau of irrigation, United States department of agriculture.

Of the graduates in electrical engineering, Messrs. F. H. Miller, F. Riebel, Jr., Hartley Rowe, F. H. Nealis, H. Berthold, R. H. Davidson and L. J. Kirby have entered the employ of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.; J. G. Anthony has accepted a position with the Bullock Electric Manufacturing Company, Cincinnati, Ohio; L. D. Waldron, with the Commercial Electric Company, St. Louis, Mo.; R. G. Mansfield and M. E. Weidner, with the Stanley Electric Manufacturing Company, Pittsfield, Mass.; George D. Babcock, with Syracuse University; F. C. Watson, with the Norfolk & Western Railway Company, Roanoke, Va.; J. M. Reynolds, with the Western Electric Company, New York city; J. R. Whitehead and Frank Loring, with the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.; J. R. Gregory and W. J. Drury and C. E. Layton, with the Western Electric Company, Chicago, Ill.; Clyde Keirn, with the Chicago Edison Company; R. M. Harris, with the electrical department of Purdue University; C. C. Bradbury, with the Underwriters' Laboratory, Chicago, Ill.; W. M. Hinesley, Dayton Railway Company, Dayton, Ohio; W. C. Martin, with the Arnold Electric Power Station Company, Chicago, Ill.; H. E. Smiley, with the Chesapeake & Potomac Telephone Company, Baltimore, Md.; A. P. Wood, with the Fort Wayne Electric Works, Fort Wayne, Ind.; C. E. Kailer, with the Indianapolis & Northwestern Traction Company, Lebanon, Ind.; H. H. Arnold, with the Indianapolis Light and Power Company, Indianapolis, Ind.

The total enrolment of Purdue University during the year just closed was 1,440. Of this number, 418 were students in the electrical department, distributed as follows: seniors, 58; juniors, 90; sophomores, 125; freshmen, 145.

Rubber Culture in Mexico.

In a recent report United States Consul Edward M. Conley, at Mexico City, discusses the outlook for rubber culture in Mexico. In spite of repeated warnings, many persons in the United States continue to invest their savings in rubber companies of which they know nothing. While, theoretically, rubber culture is an alluring proposition, thus far it has never yielded practical results. It was experimented with for years in other countries before its cultivation was undertaken in Mexico, and according to a recent report of the United States Department of Agriculture, the experiments have always been failures. There is no reason to believe that its cultivation in Mexico will be any more successful.

The cultivation of rubber is based upon the supposition that the supply of wild rubber will be exhausted or greatly curtailed; but this hypothesis is uncertain. The regions from which the supply now comes are still largely unexplored, and the discovery of new areas of rubber-bearing vegetation, and even of new rubber-producing species, is not infrequent, and may continue for years. Moreover, the progress of science may enable the extraction of rubber from juices not now utilized, and the discovery of such a process might change the entire aspect of the rubber industry. There is also the possibility that rubber may be manufactured synthetically from turpentine.

It is estimated that there are 1,000 different species of plants containing rubber, but only forty or fifty yield it in commercial quantities; hence it is very essential that any one who attempts the cultivation of rubber should be thoroughly familiar with the botany of the rubber-producing species.

The first experiments in rubber cultivation were made with the Para rubber tree. In Java Dutch experimenters have come to the conclusion that, even if the experiments were a success, the expense of running tropical plantations would make rubber cultivation unprofitable. In Mexico the *Castilloa elastica* is being cultivated as a shade tree for coffee plantations, but without success. It is believed by those who are familiar with the subject that the conditions under which this tree will thrive and produce rubber are only to be found in unsalubrious climates, where labor is scarce and uncertain.

Supposing that the trees may be grown successfully, Consul Conley believes that the expense of collecting the juice would be greater than that of obtaining it from the wild trees. In the first place, plantations must be cleared and the trees planted and protected for a number of years. The milk is then harvested by paid labor, and the work must be done carefully in order that the trees may not be injured. On the other hand, the milk from wild trees is collected by natives, who can gather the product in their own unvalued time from trees which it has cost nothing to grow. It is said that as yet no successful method is known of coagulating the milk of the *Castilloa elastica*, and considerable expensive experimentation will have to be carried out before a method is found. Rubber culture is a very complex problem, and is far from being past the experimental stage. Indeed, it is not far advanced in that stage.

Case School of Applied Science.

The catalogue of the Case School of Applied Science, Cleveland, Ohio, describes the courses of instruction offered at that institution. These include civil engineering, mechanical engineering, mining engineering, physics, chemistry and general science. During the past year there were in attendance 453 students.

The Canadian Electrical Association.

Proceedings and Papers at the Fourteenth Annual Convention, Held in Hamilton, Ontario, June 15, 16 and 17, 1904.

THE fourteenth annual convention of the Canadian Electrical Association opened on Wednesday, June 15, 1904, in the assembly hall of the Hotel Royal in the city of Hamilton, Ontario, and continued in session until Thursday at 6 P. M. Among the visitors present were the following: J. J. Wright, Toronto; K. B. Thornton, Montreal; A. A. Wright, Renfrew; C. H. Mortimer, Toronto; A. B. Smith, Toronto; A. A. Dion, Ottawa; Gordon Henderson, Hamilton; B. F. Reesor, Lindsay; C. K. Green, Hamilton; C. B. Hunt, London; J. A. Kammerer, Hamilton; John Yule, Guelph; Henry D. Payne, Montreal; H. D. Fisk, Peterboro; R. J. Smith, Perth; T. R. Price, Toronto; J. M. Leamy, Toronto; W. E. Reesor, Lindsay; A. McLean, Montreal; Edward F. Sise, Montreal; W. A. Bucke, Toronto; A. E. Wilson, Montreal; W. Williams, Sarnia; J. G. Archibald, Woodstock; J. W. Crawford, Durham; R. G. Black, Toronto; C. H. Abbott, St. John, N. B.; H. N. Dignum, Bowmanville; C. B. Roulet, New York, N. Y.; E. Irving, Toronto; J. A. Fletcher, Montreal; W. W. Bogart, Toronto; E. B. Merrill, Toronto; John Murphy, Ottawa; T. H. Bibbey, Boston, Mass.; R. H. Fraser, Toronto; K. L. Aitken, Toronto; J. M. Wight, Montreal; H. W. McPhie, Hamilton; W. H. Reynolds, Montreal; T. J. Mullen, Montreal; K. Hadin, London, England; F. Rose, Toronto; T. D. Lonergan, Chateau Frontenac, Quebec; Alfred Collyer, Montreal; R. M. Saxby, Whitby; C. T. Starr, Halifax; Geo. Black, Hamilton; W. V. Warren, Toronto; L. Rousseau, Montreal; C. H. Clark, Boston, Mass.; A. F. McBean, St. Catharines; E. D. McCormack, Toronto; G. C. Rough, Montreal; F. C. Whatmough, Stratford; J. Johnston, Ottawa; R. A. Stinson, Montreal; F. Chowen, Stratford; W. H. Wiggs, Quebec; Acton Burrows, Toronto; W. L. McFarlane, Cornwall; A. T. Duncan, St. Catharines; R. R. Wiley, St. Catharines; Louis W. Pratt, Brantford; R. B. Hamilton, St. Catharines; R. B. Smith, Boston, Mass.; Paul Sise, Montreal; D. S. Henderson, Hamilton; C. W. Henderson, Montreal; Frank T. Dryden, Toronto; H. Webster, Norwich; J. W. Campbell, Toronto; W. J. Ingram, Kincardine; W. C. Hawkins, Hamilton; N. S. Braden, Hamilton; John Patterson, Hamilton; John Knox, Hamilton; John Knox, Jr., Hamilton; W. H. Dudley, Toronto; T. R. Fulton, Montreal; H. M. Bostwick, Hamilton; H. P. Douglas, Hamilton; T. F. Nerien, Hamilton; Arthur Doddridge, Quebec; W. C. Brown, Montreal; L. R. Grimshow, St. Catharines; Cecil Doutre, Montreal; John W. Watts, Toronto; W. H. Fiske, Toronto; W. D. Wilgar, Toronto; T. Hilliard, Ottawa; P. E. Hart, Toronto; H. O. Edwards, Toronto; H. G. Nicholls, Toronto; Walter Nicholls, Toronto; E. B. Walker, Toronto; O. Higman, Ottawa; Frederic Nichols, Toronto; G. W. Hill, Toronto; A. H. Olstrich, Waterloo; Chas. L. Farrar, Lakefield; C. W. Schiedel, Waterloo; D. H. McDougal, Toronto; E. B. Biggar, Toronto; E. J. Bengough, Toronto; H. W. Weller, Montreal; A. C. Larkin, Toronto; A. E. Esling, Toronto; Simon Plewes, Creemore; J. A. Culverwell, Peterboro; F. B. Utley, Galt; Jas. Buchanan, Galt; F. C. Smallpiece, Toronto; G. U. G. Holman, Levis; and J. P. Thomson, Toronto.

The president, Mr. J. J. Wright, manager of the Toronto Electric Light and Power Company, occupied the chair and called the meeting to order.

Mayor Morden, of Hamilton, extended a welcome on behalf of the city to the convention.

In his annual address the president recalled the occasion when the first annual convention of the Canadian Electrical Association was held in Hamilton, twelve years ago, on June 15, 1892; that the interval which has elapsed between the holding of the first convention and the present time covers practically the entire development of long-distance transmission of electricity; that these have been twelve strenuous years in electrical development, and what was then a very weak and puny infant has grown into a giant like Briareus with a hundred arms; that the results of this progress are to be seen upon every hand, on the railroad, in the workshop, in the storehouse and in the dwelling; he referred to the endorsement of the application made to the minister of inland revenue for the better utilization of the resources of the inspection bureau of the government; he suggested that the committee appointed to confer with the underwriters could do good work if it were to succeed in inducing the insurance companies to investigate thoroughly the cause of the many fires that are continually taking place. He said that insurance companies do not pay sufficient attention to what may be called the moral risk in their business, and by their readiness to accept the wire theory, are simply encouraging the unscrupulous to take advantage of them; that the chief of the fire department of Toronto has said that sixty per cent of the fires that take place are of incendiary origin. The president was of the opinion that, if anything, this estimate is too low, and if the cause is, in many cases, not absolutely direct arson, it is criminal carelessness, not many removes from it; that the blind acceptance of the wire theory without investigation is simply an encouragement to the careless or fraudulent insurer.

The report of the secretary-treasurer, Mr. C. H. Mortimer, was read, showing the membership had increased to 375, as compared with a membership of 344 a year ago, an increase during the year of thirty-one. The receipts for the year were $1,562, and there was a balance on hand of $842.65.

Mr. J. A. Culverwell read a telegram from the mayor of Peterboro inviting the association to hold its next convention at Peterboro in 1905.

On motion the report of the secretary-treasurer was received and referred to the auditors.

Under the heading of "reports of committees," the "special committee on legislation for the province of Ontario" presented a report showing receipts from all sources of $150.06 and a deficit of $131.97.

A paper on "Alternating-Current *vs.* Direct-Current Arc Systems" was read by Mr. W. L. McFarlane, in which the writer fixed the cost of power at $15 for twenty-four hours' service, but, on this being questioned, he said that the price fixed by his paper was an arbitrary figure and might just as well have been $5 or $100 as $15.

In a paper by Mr. E. B. Walker on "The Origin and Development of Storage Batteries," the writer said that in 1801 Gauthert pointed out that if two metals (platinum and silver) were immersed in an electrolyte and a current passed through them, a secondary current could be obtained in the opposite direction by joining the two metals by a conductor; that in 1842 Grove observed that if two gases of strong chemical affinity were connected by pieces of metal through an electrolyte, a current would pass until

the two gases were exhausted; that on sending a current through the platinum and acid from a primary battery, the gases were formed again by electrolysis, thus storing a small supply of electricity, represented by the volumes of the gases; that in 1859 Gaston Plante discovered that if a current were passed through two plates of lead immersed in dilute sulphuric acid, a small current could be obtained for a short time, in the opposite direction to the charge, by joining the two plates with a conductor. This was due to the formation of lead peroxide on one of the plates, causing a difference of potential. G. Plante also observed that by a series of charges and discharges the quantity of lead peroxide on one plate was greatly increased, while a spongy surface of pure lead was formed on the other, and as this increased the capacity of his battery, he was able to construct a cell that was of some practical value; that in 1879 R. L. Metzger partially overcame this by mechanically applying to a lead plate active material in the form of a paste of lead oxide; and that this important improvement was not generally known until Camille Faure obtained patents on a similar process, which is now known as the Faure system; that Faure's first experiment was to cover an ordinary Plante plate with lead oxide, but he subsequently improved this by using an antimonious lead grid, with a paste of red lead, and sulphuric acid for the positive and litharge and sulphuric acid for the negative; that we have two methods of making a storage battery, both of which have striking advantages, and both, unfortunately, striking disadvantages. The advantages and disadvantages in the Faure system being almost diametrically opposed to those of the Plante; that the term antimonious lead grid is used by the writer in a general way to represent those alloys of lead, antimony, arsenic and tin which have been made with a view to obtaining increased strength and immunity from the electrolytic effects of the current on charge and discharge, some of which are quite successful, but the manufacturers keep the exact composition secret; that, on the other hand, the conductivity is lower than in the Plante, as it is difficult to obtain good contact between the active material and the grid; that the expansion and contraction on charge and discharge is apt to loosen the active material and render it liable to fall out; that very heavy discharges are likely to force off the active material by forming gases inside of it; that in order to increase the capacity per pound, many methods of increasing the active surface of the lead plate have been devised, some of which are:

1. Lead plates are scored all over with a sharp tool which raises fine leaves on the surface and increases the area, in some cases, to seventeen times the superficial area.

2. Grooves are cut in a thick plate generally by sawing.

3. Plates are built up of alternate laminæ of flat and corrugated lead, which are burned together at the ends. That plates of the latter type expand and contract laterally across the surface and consequently are sure to buckle sooner or later, as it is manifestly impossible to keep this expansion and contraction the same for both sides of the plate. The writer gave the following list of diseases and their remedies:

1. Shedding of active material and loss of capacity.
2. Corrosion of plates.
3. Buckling.
4. Sulphatation.
5. Formation of lead growths from negative to positive.

1. Shedding of active material and consequent loss of capacity is caused by too rapid discharges, forming gases which force out the active material. Loss of capacity is further caused by the formation of excessive lead sulphate, which often clogs the pores of the lead sponge and forms a layer between the grid and the active material. The shedding of active material is also due to the following causes: imperfect application of paste; overcrowding of active material in the formation of Plante plates; discharging at too high rates.

2. Corrosion of plates is caused chiefly by the presence of lead dissolving chemicals in the electrolyte; on this account it is advisable, in replacing loss by evaporation, to use distilled water, unless very pure water is otherwise obtainable.

3. Buckling is due to heavy rates of discharge, which cause unequal expansion. It can also occur at low rates, if the active material is unequally applied.

4. Sulphatation; an excess of lead sulphate is formed when a battery is overdischarged. It can be removed by overcharging at a low rate, but, if allowed to remain long after formation, it hardens, and on account of its low conductivity can not be reduced by its recharging.

5. The formation of lead trees, which we have already mentioned, has been overcome by the use of the box negative and wood separators previously referred to.

There are many more uses of the storage battery than would occur to the layman. The simplest and most apparent application is "straight" storage work, as used in connection with automobiles. The efficiency of this method is not very high, about seventy-five per cent being a fair average. However, by intelligent handling much higher efficiency may be obtained, eighty-five per cent being about the maximum.

The next example of "straight" storage work is the use of batteries for supplying lights at night, after the generators are shut down. This necessitates some method of controlling the voltage of the battery, which will drop from 2.1 volts per cell at the beginning of discharge to 1.75 at the end, with an average of 1.92 to 1.95. The three standard methods of regulating this discharge voltage are (1) resistance, (2) end cells, (3) counter-electromotive-force cells. The resistance method is the simplest, but it is very unsatisfactory except when lights are burned continually, as every time a light is turned on or off the rheostat handle must be adjusted. Another feature of storage batteries for work of this kind is the necessity of higher charging voltage than the bus pressure. Storage batteries are now very generally used in regulating the rapid fluctuations in railway and other power circuits. Here the battery charges and discharges with fluctuations in the station load and consequently does not have time to reach the higher portion of the charging voltage curve nor the lower portion of the discharge curve, thus raising the efficiency of the battery as high as ninety-two to ninety-five per cent. For work of this nature the battery will require a line voltage which fluctuates more than the battery voltage, or some means of regulating the latter so that the battery may take its share of the load automatically. A highly fluctuating voltage is not usually permissible except out on a long railway feeder where it can not be helped. A battery installed at such a point will reduce the fluctuations in voltage, and by supplying a source of power at the point of application will lessen the copper drop, as loads between it and the power-house will be fed both ways.

The "Question Box," edited by Mr. A. A. Dion, of Ottawa, created a great deal of interest, and brought to that gentleman a well-merited vote of thanks from the association for the time and trouble devoted by him to preparing the questions and answers in the published volume of the "Question Box."

On Thursday afternoon the election of

officers took place, which resulted as follows:

Mr. K. B. Thornton, Montreal, president.

Mr. A. A. Wright, M. P., Renfrew, first vice-president.

Mr. George Black, Hamilton, second vice-president.

Mr. C. H. Mortimer, Toronto, secretary-treasurer.

Executive committee—A. B. Smith, Gordon Henderson, J. A. Kammerer, John Murphy, J. J. Wright, A. A. Dion, B. F. Reesor, C. B. Hunt, Fred Thompson.

A paper on "Aluminum Wire as a Conductor" was presented and read by Mr. Roderick J. Parke, E. E., of Toronto. Mr. Parke produced, as explanatory to his paper, samples of aluminum and copper wire, showing the methods of joining the ends of the wire.

Mr. Frank C. Smallpiece gave a most interesting talk, illustrated with lantern slides, on the Curtis steam turbine.

Mr. K. L. Aitken also gave an interesting and instructive talk on "The Niagara Power Development," showing by lantern slides its progress since the inception of the work.

Mr. P. M. Lincoln read a valuable paper on "Heavy Electric Traction by Alternating Currents," implying that in the future steam traction would be displaced by electric traction almost entirely as soon as the exponents of the steam traction roads could be convinced of the advantages of electricity over steam from the standpoint of cost of performance of the work required to be done.

The standard system of the accounting for electric companies, as recommended by the National Electric Light Association, was approved, so far as practicable, but in the opinion of many members was too complicated for small plants; a uniformity of accounting being deemed to be most necessary by the various speakers on the subject.

After passing the customary votes of thanks, three hearty cheers were given for the retiring president, Mr. J. J. Wright.

The convention adjourned to meet in 1905 in the city of Montreal.

The Electric Furnace.

An authorized translation of "The Electric Furnace," by Henri Moissan, is being made by Dr. Victor Lenher, of the University of Wisconsin. The book will contain about 305 octavo pages, bound in cloth, and will be published by the Chemical Publishing Company, Easton, Pa.

BOOK REVIEWS.

"Modern Electricity." James Henry and Karel J. Hora. Chicago. Laird & Lee. Cloth. 355 pages. 5 by 6½ inches. 150 illustrations. Supplied by the ELECTRICAL REVIEW at $1, cloth binding; $1.50, leather binding.

This book is put forward as a manual of the theories, principles and applications of electrical science. Electrical principles and phenomena are discussed in a brief and elementary way, frequent examples being introduced to make the explanation clearer. The book makes an ambitious attempt to cover the entire subject and to bring the science up to date. It contains a good deal of information for those who have no need to go into the subject fully.

"Uses of Electricity on Shipboard." J. W. Kellogg. New York. Marine Engineering. Cloth. 78 pages. 5¾ by 8¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This little book is not intended as an exhaustive treatment of the use of electricity on shipboard, but gives a concise and simple discussion of the subject. The early installations are first described, the type of machinery used in them being contrasted with the modern marine equipment. Chapter ii is a general consideration of a modern marine plant, chapters iii and iv taking up the questions of wiring, insulation, electric lighting and fixtures. The question of electrically driven auxiliaries is considered in chapter v, and in chapter vi a practical application of these principles is made by considering the case of a small steamer. An appendix by Mr. D. A. Richardson takes up the subject of small lighting plants for launches; storage batteries, small belt-driven generators and small direct-connected systems being discussed.

"Mechanical Drawing Simply Explained." F. E. Powell. The Model Engineer Series, No. 21. London. Percival Marshall & Company. Paper. 78 pages. 5 by 7¼ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at 25 cents.

This little book gives a good deal of valuable information to the beginner in draughting. Of course, in a volume of its size, there is very little opportunity for the introduction of plates which will show very much. There is a good chapter on the use and care of drawing instruments, and, if the information is followed, it will be of assistance to the learner. In the chapter on inking in and finishing drawings, considerable good space is given up to a description of methods of preparing drawing ink. This should be unnecessary at the present day, because there are on the market a number of very reliable India inks which certainly are an improvement over anything which the amateur can mix for himself. The instruction follows the usual text-book practice, and the work does not differ from what all mechanical engineers are used to.

"General Index to the Street Railway Journal." New York. McGraw Publishing Company. Cloth. 162 pages. 7½ by 10½ inches. Supplied by the ELECTRICAL REVIEW at $5.

This index covers the articles in the American edition of the *Street Railway Journal*. From 1898 to 1902, inclusive, the foreign subscribers to the *Journal* were supplied with an edition which differed somewhat from the American edition. From 1900 to 1902, inclusive, while the American edition was being published as a weekly, and the international edition was being published as a monthly, these differences were so great that the index would be useless if applied to the international edition. Since January 1, 1903, the reading pages of the two editions have been uniform in every particular. No attempt has been made to preserve the original captions of the articles. Except in the author's index, the index is one of subjects, not of titles; and in a long article, where different topics have been treated at length, separate entries of these topics have been made as far as possible.

"Traité Elémentaire des Enroulements des Dynamos a Courant Continu." F. Loppé. Paris. Gauthier-Villars, Imprimeur-Librairie. Paper. 80 pages. 4½ by 7¼ inches. Figures and 12 plates. Supplied by the ELECTRICAL REVIEW at $1.

The author of this book, who is professor of industrial electricity in the municipal trade school of Diderot, Paris, in discussing dynamo winding before his classes has found it necessary to treat the subject in a manner as simple and practical as possible, without resorting to theoretical dissertations or mathematical analyses. It has been his endeavor, at the same time, to add interest to a subject naturally somewhat dry. He commences by considering the most simple cases first, deducing from these the most complex. The work is not put forward as containing any new matter, but the method of treatment seems to justify the publication. It considers only closed-circuit ring and drum-wound armatures. The first chapter is upon bipolar dynamos, and in it the fundamental principles are given. The second chapter is upon multipolar machines.

"Patents Simply Explained." The Model Engineer Series, No. 20. London. Percival Marshall & Company. Paper. 84 pages. 5 by 7½ inches. Plans and sketches. Supplied by the ELECTRICAL REVIEW at 25 cents.

This book is intended as a guide to inventors and others interested in taking out patents for inventions. The author

has assumed that the reader has no idea as to what to do or how to find the necessary information to enable him to protect an invention. The book deals entirely, however, with questions concerning applications for patents in the United Kingdom. The work takes up in detail the protection of an invention, the necessary forms which must be complied with, and the fees paid. Chapter ii deals with specifications and drawings. Chapter iii gives general information on patents, and chapter iv describes the Patent Office and its methods. Chapter v takes up the working of a patent. Chapter vi takes up foreign patents and their relation to the Patent Office of the United Kingdom. Chapter vii takes up the subjects of what can be patented and who can be a patentee. Chapter viii describes patents agents and their work, and chapter ix the registration of designs and trademarks.

"Electric Lighting for Amateurs." The Model Engineer Series No. 22. Edited by Percival Marshall. London. Percival Marshall & Company. Paper 80 pages. 5 by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This little book is intended to be a practical guide to the installation of the electric light on a small scale. It contains a good many useful hints for the amateur, but it deals also with phases of the work which few amateurs will care to undertake. For instance, chapter i shows how small incandescent lamps may be made, giving detailed directions. Chapter ii is of more practical value, taking up the problem of fitting up small electric lamps. In the remaining chapters of the book, intermittent electric lighting, the construction of an electric night light and a portable electric lamp are considered. Chapter vi and chapter vii will be of value, as they describe the making and care of a small storage battery. The last chapter of the book is upon an amateur dynamo electric lighting plant. Even those parts of the book which the average amateur is not likely to follow are of value, as they will give him a clearer idea of the methods of making lamps and batteries than he is apt to obtain from the usual text-books.

"A Text-Book on Static Electricity." Hobart Mason. New York. McGraw Publishing Company. Cloth. 155 pages. 6 by 8½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

The author of this book, who was until recently assistant in electrical engineering at the Polytechnic Institute of Brooklyn, has endeavored to bring together here all available information regarding static electricity. This is a branch of the science which until recently has been sadly neglected, and of which most engineers and students possess but a limited knowledge. The general phenomena of the subject are first described, and this is followed by the deductions of fundamental electrostatic laws. In chapter iii the subject of capacity is treated, this being followed by methods of measuring capacity in chapter iv. In chapter v measuring instruments, both scientific and commercial, are described and explained. The last chapter is devoted to static generators, particularly high-potential generators, and gives some interesting information regarding the efficiency of such machines. There is an appendix upon units, and their dimensions and ratios. The book should prove to be exceedingly valuable, since it brings together, in convenient and attractive form, a great deal of valuable information which has heretofore been widely scattered.

"Spangenberg's Steam and Electrical Engineering, in Questions and Answers." E. Spangenberg, Albert Uhl and E. W. Pratt. St. Louis. George A. Zeller. Cloth. 672 pages. 6 by 9 inches. 648 engravings. Supplied by the ELECTRICAL REVIEW at $3.50.

The first 360 pages of this book are upon the subject of steam and steam engineering. This part of the work is treated catechetically. The electrical information is contained in 208 pages, the remainder of the book being devoted to compressed air, gas and gasoline engines, mechanical refrigeration, and a chapter on hints for making repairs. The part treating of the science and practice of electricity starts from the bottom by defining the electrical units and by stating the fundamental laws. This method of treatment will probably repel some readers, as they will soon find themselves beyond their depth. The statement of a law is hardly sufficient for a beginner. Reasons should always be given. The method of dealing with the subject is well illustrated by the following quotation: "The unit of electric energy is called the Watt, and is usually represented or abbreviated P. One thousand watts are called a kilowatt, or K. W. To find the watts in any circuit, multiply the voltage by the current, thus: Volts × amperes = watts." This is the entire explanation of one of the fundamental electrical laws, although a simple example illustrating the law is given. The quotation also shows that occasionally the author is careless in his use of terms, an unfortunate fault for the author of a text-book. The watt is not the unit of electrical energy. The work passes over the fundamental principles quickly, dealing with electrical science in twenty pages, and magnetism in four. We are then plunged into the theory of the dynamo, and are carried quickly through dynamo construction, different types of machines, motors and measuring apparatus. Electric lighting receives a comparatively full treatment in thirty pages. Alternating currents are then taken up, the principles being explained by the aid of elementary mathematics. This is followed by distributing systems. The method of treatment is one which calls for a good memory, rather than a logical mind.

The Turbo-Electric System in Mining Work.

The Newhouse Mines and Smelter Company, Samuel Newhouse, president, has adopted Westinghouse steam turbines and electrical apparatus for furnishing power in its mining operations in Utah, and for local lighting. Mining operators have but lately awakened to the advantages of the turbo-electric system in securing economy in mine operations, and the Newhouse plant thus will be of great interest in this particular field. A notable precedent has already been established by the adoption of turbines of the same make by the DeBeers Mining Company, Limited, South Africa, where two 1,000-kilowatt Westinghouse-Parsons turbines are already in operation and a third is under construction.

The Newhouse Mines and Smelter Company's new power station is situated twelve miles from Frisco, Utah, at the terminus of the Oregon Short Line Railroad, which is now under construction. Electric power will be used both for operating the mining machinery and also to furnish light for the town of Newhouse. Power will be generated at 440 volts and transmitted at 2,300 volts a distance of 9,000 feet from the power plant to the mines where it will be stepped down to 400 volts for the motors in the concentrating mill and crushing department situated at the mouth of the tunnel. Power will also be used to drive a motor-generator set for the operation of mining type locomotives in the main tunnel. The entire electric system is three-phase with a frequency of 7,200 alternations per minute.

The generating plant consists of two 400-kilowatt Westinghouse-Parsons turbines with three-phase generators of like capacity. The turbines will operate under 150 pounds pressure, twenty-seven inches to twenty-seven and one-half inches vacuum, and approximately eighty degrees Fahrenheit superheat at the turbines. An individual surface condenser will be provided for each turbine. The boiler plant will consist of three 280-horse-power Babcock & Wilcox boilers operating at a steam pressure of 155 pounds, with superheat at the boilers of 100 degrees Fahrenheit.

The plant is being erected and equipped under the charge of Robert F. Moser, M. E.

The Case of Mr. Edison and the Patent Office Examiners.

A matter which has attracted a great deal of interest in the scientific world is the series of charges which Mr. Thomas A. Edison preferred some time ago against several patent-office examiners. This matter concerned an alleged deviation from proper practice in the case of Mr. Edison's patents on his new storage battery and the patents of the Swedish scientist, Jungner. Mr. Edison, in his complaint, charges Principal Examiner T. A. Witherspoon and Assistant Examiner A. M. Lewers, of the patent office, as follows:

"With incompetence, neglect of duty and maladministration of office in connection with the grant of United States patent to Ernest W. Jungner for reversible galvanic battery No. 738,110, dated September 1, 1903; wherefore your petitioner and the public generally has and have suffered great and irreparable injury, and to the reproach and scandal of the patent office."

The specific charges are three in number:

"First—The examiners in question allowed the Jungner patent to issue when they knew or should have known that such issue was fraudulent.

"Second—The examiners allowed the said patent to issue containing claims which they knew were unpatentable, and which, in fact, they had declared to be unpatentable, and which Jungner himself had admitted were unpatentable.

"Third—The examiners granted the said patent for an inoperative invention, which fact had been previously brought directly to their attention and acknowledged by them."

At the direction of the commissioner of patents Mr. Edison was given a full and complete hearing, which took place on April 4, 1904, to suit the convenience of his counsel, Mr. A. D. Worthington, Mr. Melville Church and Mr. Frank L. Dyer. In connection with this matter Mr. Frank L. Dyer, of Mr. Edison's counsel, made a statement from which the following has been quoted:

"Jungner apparently bases his case entirely on an application for a patent filed in March, 1899, but that application was entirely foreign to anything suggested by Mr. Edison, as it described entirely different active materials, not only specifically, but in their general character, and an entirely different mechanical construction. * * * It appears that after the Edison patents issued in 1901, Jungner sought by amendment to include in his original application of March, 1899, some of the chemical and mechanical features of the Edison battery, in order to lay the basis for a claim covering the Edison battery; but the patent-office examiners in charge of these inventions detected the obvious character of such a subterfuge, and refused to permit the amendments to be made, on the ground that they embodied what is technically called new matter."

Mr. Dyer then states that Jungner "in June, 1902, filed an application for a patent that was represented as being a division of his original application of 1899. * * * Notwithstanding this fact, however, Jungner, in his alleged divisional application, introduced the same features of new matter that he had been prevented from introducing by way of amendment of his original case, and a patent was therefore granted to him on September 1, 1903, disclosing chemical and constructional features that had been invented by Mr. Edison and disclosed in Mr. Edison's patents in 1901."

In his statement Mr. Dyer relates the law establishing the validity or lack of validity of a patent granted in this way, and considers the further reasons leading up to the preferment of charges as follows:

"Charges were therefore filed against the examiners, in order that they might either be dismissed or transferred to some other examining division. These charges were referred by the Secretary of the Interior to the Commissioner of Patents, and the latter gentleman reported that he had looked into them and believed that they were without merit, and therefore recommended that no opportunity whatever be given to present them by way of argument. At this stage of the proceedings I saw President Roosevelt, who promptly decided that any respectful request which Mr. Edison might make was at least entitled to an orderly investigation, with the opportunity of a hearing; and it was therefore suggested to the Commissioner that this be done. Since the Commissioner had already informally passed upon the case, the matter was referred by him to his assistant, Mr. Moore, before whom, on April 4 last, a very full argument was made.

"I have before me the report of the assistant commissioner, of May 24, 1904, to the Secretary of the Interior, in which the charges are very patiently, exhaustively and fairly investigated, and in which our position is sustained in every important respect. Among other things the assistant commissioner says:

" 'It follows therefore that the disclosure in the Jungner patent is a different invention from that originally disclosed by him in his parent application, and therefore there is no basis in the original disclosure for the disclosure of his patent.

* * * * * * * * * * *

" 'I find therefore, that the examiners erred in allowing the Jungner patent as a division of the earlier application, as the patent is not in fact a division, for the reason that it not only contains new descriptive matter relating to its mechanical structure, but the invention disclosed is so changed as to be in fact another invention from those originally disclosed in the early application and that the patent therefore as to this new matter is effective only as to its new filing date.' "

"And in his conclusion he says:

" 'To so view the effect of the enlarged and changed description of the patent to Jungner, is in my opinion a grave error of judgment, and in view of the statements of the examiners above referred to, the conclusion is inevitable that they are unable to appreciate the fact that the description in the patent is so changed and enlarged as to cover a battery having the characteristics of the claim which they rejected on the ground of new matter in the original application.

" 'Having reached this conclusion I am of opinion that the examiners should be relieved from their present assignment in Division 3 and transferred to duty in other examining divisions of this Office, and that other examiners should be assigned to Division 3 in which division applications for patents belonging to the class of electrochemistry are examined.' "

Rubber-Growing in Siam.

In a recent report, United States Consul General Paul Nash, at Bangkok, Siam, states that rubber cultivation has been started recently in that country, and some thousands of plants have been set out as an experiment. These are of the Para variety, and are said to be doing exceedingly well, although they have had no special care, but have been planted indiscriminately in various places and under various conditions of moisture and sun. Consul Nash is of the opinion that this venture will prove highly successful, and hopes to be able to report to this effect before long. The one thing to be feared, however, is the new disease which has developed in the Para rubber plantations on the Malay Peninsula.

Consul Nash also calls attention to two rubber-producing plants indigenous to Siam. The more important of these is the *Ficus elastica*, the product of which is much used in the United States for ornamental purposes, and is found in large quantities in the Siam jungle, and throughout India and Indo-China generally. The rubber is collected from these trees by making longitudinal scarifications in the bark, from which the coagulated milk is taken in long strips. A plant six years old yields four pounds annually. The other rubber-producing plant of known commercial value is a creeper of great size. It is thought to be one of the *Urceola* species. These creepers yield a fair quality of rubber, produced by cutting them into sections two or three feet long and collecting the juice, which is subsequently boiled for a moment in water and immediately coagulates in a viscous mass, which must then be dried by smoking over a fire. An inferior rubber is also extracted from the bark by pounding and boiling. These creepers grow with astonishing rapidity, and it is thought that they could be cultivated with profit in the Philippine Islands.

ALUMINUM ELECTRICAL CONDUCTORS.[1]

BY RODERICK J. PARKE.

The use of aluminum for electrical conductors has grown to an extent which renders imperative the consideration of its possibilities when designing any system of distribution.

It is so far the only material which possesses the requisite properties to render practical its substitution for copper. Previous to 1898 aluminum was little known in the commercial world, but since that year, when it was first placed upon the market in the form of solid-drawn conductors, the consumption has rapidly increased, until 1902, the date of the latest complete statistics available to the writer, the world's product was estimated at 8,000 tons per annum. The corresponding production of copper is estimated at 497,000 tons per annum, for all purposes. The statistics available up to the present, however, show that the production and consumption of aluminum is rapidly increasing and that it has become a very strong competitor of copper for electrical conductors.

There are now nine plants in the world producing aluminum, of which three are in America, two in France, and one each in Great Britain, Germany, Switzerland and Austria. The total power utilized in the production of the aluminum is from 36,000 to 40,000 horse-power, practically all water power.

The following figures are for commercial aluminum and commercial copper of sizes commonly used in practice, the copper being hard-drawn:

	Aluminum.	Copper.
Specific gravity.....	2 68	8.93
Conductivity (Matthiessen standard).....	62.	97.
Tensile strength (per square inch).....	28,000	45,000
Coefficient of linear expansion (per ft).....	.0000128	.0000093
Coefficient of temperature resistance.....	.00114	.00117
Modulus of elasticity...	9,000,000	14,000,000

Using the above figures we find that the cross-section of aluminum will have to be ninety-seven sixty-seconds or 1.564 times that of copper, to have the same resistance per foot. The weight of the aluminum will therefore be $\frac{2.68 \times 1.564}{8.93}$ times that of the copper or 0.47.

The tensile strength of the aluminum will be $\frac{28{,}000 \times 1.464}{45{,}000}$ or 0.96 that of the copper.

The diameter of the aluminum will be $\frac{\sqrt{1.564}}{\sqrt{1}}$ or 1.25 that of the copper.

The price of aluminum for equal cost would be $\frac{1}{0.47}$ or 2.13.

Tabulating these results we have:

	Aluminum.	Copper.
Cross-section for equal resistance.....	1.56	1
Diameter for equal resistance	1 25	1
Weight for equal resistance..	0.47	1
Tensile strength for equal resistance.....	0.96	1
Price for equal cost.....	2.13	1
Rate of temperature change (resistance).....	1.0	1

By inspection of the above table we see at once that the principal difference which exists from an engineering standpoint is that aluminum possesses less than half the weight of copper for equivalent resistance. This is a marked advantage and results in benefit in three ways.

1. The cost of transportation of aluminum is less than that of copper.

2. The cost of erection of the aluminum is less.

3. The durability of the line is greater and cost of maintenance is less on account of the smaller strains to which poles, cross-arms, pins and insulators are subjected.

An additional advantage of aluminum is that on account of its peculiar nature it retains, for years, some of the grease used in drawing and this grease prevents any great amount of sleet from forming upon it, thus avoiding one of the serious causes of interruption to service over pole lines. This result is rather surprising and its announcement is often greeted with incredulity, but the fact has been noted often enough to be well established.

To balance the advantages cited there are the following disadvantages:

1. Difficulty in making joints.

2. Greater sag due to larger coefficient of expansion.

3. Insufficient strength for conductors of the sizes used for telephone and telegraph wires.

Referring again to the question of sleet affecting metallic conductors, the writer was informed by a friend of his who is an electrical engineer for one of the large companies in the States, of a very practical illustration. He states that he was called to Kansas City to make an inspection of the Kansas City & Leavenworth Railroad. He happened to get there on a day while there was a very severe sleet storm in progress and he found the copper trolley wires so badly covered with sleet that it was almost impossible to run the cars at all, and they were running scrapers instead of trolley wheels and were compelled to keep a man on top of the car to assist in knocking the ice from the wire. On the other hand, the aluminum feeders, located on poles adjoining the tracks, were entirely free from sleet and he states that this condition was not due to the fact that the wires were carrying sufficient current to warm them, because that was not the case, as there was only one car on the line between the power-house and the part of the line referred to, and the feeder system was of ample size, so that the temperature rise was insufficient to have any effect in preventing the formation of sleet. In addition to this, there would be from half an hour to an hour at a time when no car would be on the line at all, and then no car whatever would be passing over the line.

It does not follow, however, that sleet will never gather on aluminum wire anywhere, because in the neighborhood of railroads and manufacturing plants the wires are likely to become coated with smoke or some other foreign substance upon which the sleet will form. In general, however, it may be safely assumed that sleet does not form upon aluminum wires.

JOINTS.

The difficulty of soldering aluminum is well known and, while it can be done, the operation in the majority of cases is attended with so much difficulty that unsoldered joints are preferable. The difficulty in soldering aluminum arises from three causes: first, because solder does not alloy with aluminum at a low temperature. It will alloy with copper at approximately 460 degrees Fahrenheit, but the alloying temperature with aluminum is about 200 degrees Fahrenheit higher. Secondly, because of the high thermal conductivity of aluminum, the latter metal conveys the heat away very rapidly from the solder and from the soldering iron, making it difficult to maintain a soldering temperature. And, thirdly, when aluminum is exposed to the air a thin invisible coating of oxide of aluminum instantly forms upon the surface, although in this respect aluminum is not different from all other metals, because the surface of any metal becomes covered with its oxide immediately after exposure to the atmosphere. It is well known that it is necessary to remove this oxide coating in order to permit of the formation of an alloy between the solder and the metal, because the alloying can only take place on a clean surface of metal and the interposing film of oxide prevents the solder from coming into act-

[1] Abstract of a paper read before the convention of the Canadian Electrical Association, held in Hamilton, Toronto, June 15, 16 and 17.

ual contact with the metal. In regard to other metals than aluminum, the oxide coating can be dissolved by means of soldering salts, but no such salt or flux, so far as the writer can learn, has been discovered for aluminum, hence the difficulty in soldering it. Attempts have been made to use various materials as fluxes to remove the oxide coating of the aluminum, but the results have not been satisfactory and in fact have been in most cases detrimental to the aluminum because of the resulting formation of a chemical compound which interferes with soldering instead of facilitating it.

For joining aluminum wires smaller than No. 0000 B. & S. gauge the two ends are inserted into a piece of flattened tube and the tube given two and a half twists by means of two pairs of ordinary wire connectors. This makes a perfectly satisfactory joint of low resistance and as strong as the wire joined.

Larger sizes are conveniently joined in any of three ways:

1. By means of the ordinary dovetail cable splice. (The Niagara Falls-Buffalo line, consisting of 500,000 circular mils of aluminum cable, is joined in this way and has been in use for three years and has given perfect satisfaction.)

2. By means of terminals compressed on the ends of the cables at the factory, these terminals being threaded and thus adapted to be united in the field by a threaded stud.

3. By inserting the ends to be joined into a cast sleeve and compressing the sleeves between dies in a small portable press.

Taps are made by means of aluminum clamps, one of which carries a lug into which the tap wire is either soldered or secured by set screws. Soldering into a lug is one of the pieces of aluminum soldering which can be readily accomplished.

It will be seen from the above that the difficulties of making aluminum joints have been reduced to an extent which leaves almost no disadvantage whatever.

SAG.

The sag of aluminum conductors is somewhat greater than that of copper in hot weather and on ordinary spans, on account of the fact that the coefficient of expansion of aluminum is thirty-eight per cent greater than that of copper.

The sag is not as much greater as might be expected, however, because the lower modulus of elasticity of aluminum causes it to contract more as the strain is relieved from it and because the weight of aluminum, for equal areas, is only three-tenths that of copper, while the strength of it is two-thirds that of copper. This causes aluminum to start with a smaller minimum sag than copper.

One curious result of this is that whereas aluminum will have a maximum sag of three or four inches more than copper in a 100-foot span, it will have actually a smaller maximum sag in a 1,000-foot span, for while the span moves further, or deflects more rapidly, than copper, for a given temperature change it starts with so much smaller sag at low temperature that it never overhauls the copper when long spans are used. On this account, and that of its small weight, it would seem to be the best material for long span work.

The use of a reliable dynamometer for stringing aluminum wire is strongly recommended, as experience seems to indicate that it is a difficult matter to obtain linemen experienced in handling aluminum wire or who can be depended upon to provide that proper sags shall be set when stringing the wire. The use of the dynamometer does not involve any greater expense for the stringing of aluminum conductors than its non-use when stringing copper conductors, because, owing to lighter weight of the former, the material can be handled much more easily and quickly than the copper can, size for size. The third objection for aluminum applies only to telegraph and telephone and similar work. The smallest size of aluminum which it would be advisable to use in pole line work is No. 4 B. & S. gauge, which has a breaking strength of about 1,000 pounds, which is the minimum strength that should be allowed in any conductor on a pole line if uninterrupted service must be given over it. The principal uses of aluminum conductors have been for railway feeders, high-tension transmissions and bus-bars. Its use in Canada has not been very extensive, due to the fact that the beginning of its manufacture there is of rather recent date. But there are a few places in the United States where it is not found in service. Very little need be said about its use for railway feeders, which have absorbed nearly two-thirds of what has so far been used. This use, however, presents no problems with which engineers are not familiar. For power transmission its use has become very extensive. The longest and largest transmissions in the world are now made over aluminum. From information furnished me by one of the manufacturers of aluminum conductors, I have selected the following list and data which may be of interest:

Locations.	No. of Cables.	Miles per Cable.	Circular Mils. Area of Each.
Niagara Falls to Buffalo.....	3	20	500,000
Shawinigan Falls to Montreal.....	3	85	183,708
Electra to Mission San Jose.....	3	100	471,034
Colgate to Oakland	3	144	211,000
Farmington River to Hartford.....	3	11	336,420
Lewiston, Me.....	3	3.5	144,688
Ludlow, Mass.....	6	4.5	135,247

In addition to the foregoing list, the lines of the Telluride Power Transmission Company in Utah, Colorado and Montana use nearly 2,000 miles of wire, involving transmission distances of 130 miles.

The question of the durability of aluminum conductors has frequently been raised since they have been brought into active competition with copper, but so far the information available shows that aluminum has thoroughly established itself as a conductor material offering no disadvantages which are not, in other respects, proportionately found in regard to copper or iron. Aluminum is not readily oxidizable and the greater number of mineral acids seem to have no chemical effect upon it, but chlorine in any of its unstable combinations is more or less detrimental to it, particularly where the conductors are exposed to sea air or where they are installed within the vicinity of certain chemical works. On the other hand, however, copper is liable to be detrimentally affected by atmospheres laden with acid fumes, consequently it would hardly be fair to condemn aluminum for lack of permanency any more than it would be to condemn copper. The most common impurity of aluminum is sodium, which forms a very unstable alloy, readily attacked and corroded in even slightly moist atmospheres. This defect, however, can be provided against by the manufacturers and no doubt the consumer can depend upon the purity of aluminum furnished by any responsible manufacturer as readily as he can depend upon the guaranteed qualities or characteristics of copper purchased from any responsible copper manufacturer.

Aluminum conductors were first placed on the market in the form of solid-drawn wire and in this form a considerable quantity of it was installed on transmission lines. Subsequent experience has demonstrated that the tensile strength of any given aluminum conductor is increased somewhat by building it up of several smaller strands wound together, and since this form has been adopted the writer has not been able to learn of any instances in which the conductors

have broken on account of deficient tensile strength, where they have been properly installed.

In connection with the installation of the electrical lighting and power distribution system along the Welland Canal, this work being now in progress, the government purchased a quantity of aluminum and copper conductors for the transmission and distributing circuits.

The writer's specifications called for Nos. 0, 2, 4, 6 and 10 B. & S. copper conductors, the No. 6 B. & S. to be medium hard-drawn and the No. 10 to be hard-drawn. Tenders were also taken as alternative, for the supply of aluminum conductors of conductivities equivalent to those of copper conductors specified, and on comparing tenders it was found that the Nos. 3/0, 0 and 2 B. & S. aluminum conductors offered as equivalents for the Nos. 0, 2, and 4 copper would cost less than the copper, and the aluminum was purchased. The aluminum equivalent for No. 6 copper, taking into consideration the tensile strength specified for the medium hard-drawn copper, was found to be more expensive than the copper, consequently copper was purchased for the No. 6 and No. 10 gauges. The writer desires to explain that the gauge numbers just mentioned for the aluminum conductors do not represent the correct relative proportions as compared with copper but are the nearest gauge numbers corresponding to the area of the aluminum conductors representing the copper equivalent.

The writer tested a proportion of the aluminum conductors for cross-section, tensile strength, torsion and resistance, and found the results given in the table below.

Approximate Gauge.	No. of Strands.	Approximate Gauge of Strands.	Twists in 6 Inches.	Breaking Strains per Square Inch.	Elongation in 6 Inches. Per Cent.	Results per 1000 Feet at 75° Fahrenheit.
		B. & S.		Lbs.		
000	7	7	21	29100	2	0.106
0	7	9	22	33000	2-2/3	0.172
2	7	10	30	35500	3-1/3	0.262

The above mentioned results of the tests seem to show that the tensile strength increases somewhat with a reduction in area of the smaller strands composing the conductor.

Also it will be seen that the conductivity of the aluminum conductors as compared with that of pure copper conductors of the equivalent smaller gauges specified, is approximately 99.3, 98.5, and 99 per cent, respectively, and the respective breaking strains of the aluminum, per square inch, exceed the breaking strain usually allowed for soft copper (pure), namely, 23,600 pounds.

The questions are often asked, with relation to alternating-current work, as to the respective capacity, self-induction and skin effects of aluminum and copper.

As aluminum is one-quarter greater in diameter than equivalent copper, it is evident that the self-induction of the line will be the same when the aluminum wires are separated twenty-five per cent more than the copper wires.

The static capacity of the aluminum will be approximately five per cent greater than that of copper, with the same spacing.

The skin effect will be exactly the same with either of the two metals, since the effect of the greater diameter of the aluminum is exactly offset by its greater specific resistance, in making the calculations for the per cent of increase of resistance.

All practical transmission lines possess sufficient excess of self-induction over capacity to cause a slight lag in alternating currents, and the power-factor over an aluminum line would therefore be slightly better than that over a copper line, on account of the smaller self-induction and greater capacity. The difference is small, but what there is, it is in favor of aluminum.

The market prices of aluminum and copper have always been such, for the past five years, that from five per cent to fifteen per cent can be saved by the purchase of aluminum.

For instance, the present market price of copper is about fourteen cents. An equivalent price of aluminum would be 29.8 cents, whereas aluminum can be had to-day for 27.5 cents, or the equivalent of thirteen-cent copper.

In view of all the facts, it would seem that we are no longer compelled to confine ourselves to a single material for carrying current as was formerly the case.

Electric and Compressed-Air Locomotives for Mines.

A paper discussing electric and compressed-air locomotives for mines was read at a recent meeting of the British Institution of Mining Engineers. The author holds that both types of locomotive are good, and that the choice between them is entirely a question of the conditions obtaining in each case. The pneumatic locomotive is cumbersome and large, while the electric is better adapted to low seams. On the other hand, the pneumatic is safer where fire damp prevails. The disadvantage of the time lost in charging a compressed-air locomotive is not as great as might be expected, since, in any case, there is a good deal of time wasted at terminals, which may be utilized for charging. However, there is always the possibility of exhausting the supply when an exceptionally hard piece of work must be done. As against the electric system, there is the expense involved in wiring and the difficulty in passing around short turns.

The greatest difference in cost is found in the generation of power. On this point the author has had an opportunity of examining the actual cost of plants in successful operation, and the results are given in the following tables:

A—Compressed-air plant operating two main hauling locomotives, each weighing 30,000 pounds, and five gathering locomotives, each weighing 8,000 pounds, a total weight of 100,000 pounds. The cost was as follows:

A 3-stage air compressor and a compound steam engine	$5,350
5,600 feet of pipes, 5 inches diameter	5,660
3,100 " " 2¼ " "	1,795
1,000 " " 1½ " "	305
2 locomotives, each weighing 30,000 pounds	6,070
5 " " " 8,000 "	10,110
2 boilers, each of 80 horse-power	1,010
Installation	4,040
Total	$34,280

B—Electric plant of four locomotives, each weighing 26,000 pounds, a total weight of 104,000 pounds. The cost was as follows:

Generator, producing 225 kilowatts	$3,940
Engine, 500 horse-power	4,860
Boilers, 600 "	4,445
Foundations, piping, etc.	1,525
Wiring	8,110
4 locomotives, each weighing 26,000 pounds	9,620
Total	$32,490

C—Electric plant, comprising two locomotives, each weighing 26,000 pounds, a total weight of 52,000 pounds. The cost was as follows:

Generators, etc.	$21,300

The A plant was installed and is being operated under the direction of the author. The costs for B and C plants were supplied by the superintendent now in charge of their operation; the B plant was installed under his direction, and the C plant by his predecessor. There is no reason to suppose that these values are to any extent misleading, and as the gentleman is a pronounced electric enthusiast they are certainly not exaggerated.

Railway Men in Convention at Saratoga Springs, N. Y.

The thirty-eighth annual convention of the Master Car Builders' Association was held at Saratoga Springs, N. Y., June 22, 23 and 24. The convention established headquarters at the Grand Union Hotel. The three days' sessions were given up to the customary reports of the officers and standing committees. A number of papers were read, and topical discussions followed.

The thirty-seventh annual convention of the American Railway Master Mechanics' Association was held at Saratoga Springs, with headquarters at the same place, June 27, 28 and 29. The following programme was announced:

MONDAY, JUNE 27, 9.30 A. M.

Prayer; president's address; reports of secretary and treasurer; assessments and announcement of annual dues; election of auditing committee; unfinished business; consideration of matters affecting the conduct of the association; appointment of committees on correspondence, resolutions, obituaries, nominations, etc.; discussion of report on ton-mile statistics; discussion of individual paper on "Grates for Bituminous Coal," by J. A. Carney, master mechanic, C. B. & Q. R. R.; discussion on coal consumption on locomotives and locomotive front-ends.

MONDAY, JUNE 27, 7.30 P. M.

Topical discussions:

"For lubricating main side rods and driving box bearings, which is the better practice, grease or oil?" To be opened by Mr. T. S. Lloyd.

"With the large modern engines equipped with power brakes, is not screw reverse mechanism preferable to present hand lever arrangement, and is quick reversal a vital consideration? To be opened by Mr. James McNaughton.

"What is the best practice with reference to providing air spaces under locomotive grates, especially with wide firebox locomotives?" To be opened by Mr. F. J. Cole.

"What is the best method of caring for exterior of locomotive front-ends, from the standpoint of cost and appearance?" To be opened by Mr. W. O. Thompson.

TUESDAY, JUNE 28, 9.30 A. M.

Discussion of reports: locomotive driving and truck axles, and locomotive forgings; boiler design; revision of standards; air brake and signal instructions; piston valves; individual paper on "Machine Tools," by H. H. Vaughn; individual paper on "Technical School Graduates," by R. D. Smith; individual paper on "Terminals for Locomotives," by R. Quayle.

TUESDAY, JUNE 28, 3 P. M.

Topical discussions:

"Packing for air pumps for high-speed brakes." To be opened by Mr. A. J. Cota.

"The advisability of reducing the diameter of stay bolts and shortening the space between the stay proportionately." To be opened by Mr. G. R. Henderson.

"Leaky flues in wide fire-boxes." To be opened by Mr. M. K. Barnum.

"Limit of width of soft-coal-burning fire-boxes with reference to high evaporation efficiency." To be opened by Mr. S. M. Vauclain.

WEDNESDAY, JUNE 29, 9.30 A. M.

Discussion of individual paper by Mr. W. R. McKeen, Jr., on "Tool Steel;" report of Master Car and Locomotive Painters' Association on painting locomotives; individual paper by Mr. C. A. Seley, on "Variable Motors." Reports: automatic stokers, locomotive frames, cost of locomotive repair shops, safety appliances for locomotive front-ends. Correspondence and resolutions; election of officers.

The exhibitors turned out in unusually good numbers, and the displays were visited by a great many interested delegates. Among those who had exhibits in place at the opening of the convention were the following: American Steam Gauge and Valve Manufacturing Company, Jamaica Plains, Boston, Mass.; American Brake Shoe and Foundry Company, New York city; Anti-Friction Bearing Company, Pittsburg, Pa.; William C. Baker, New York city; Buffalo Forge Company, Buffalo, N. Y.; the Carborundum Company, Niagara Falls, N. Y.; Chicago Car Heating Company, Chicago, Ill.; Chicago Pneumatic Tool Company, Chicago, Ill.; Cleveland Car Specialty Company, Cleveland, Ohio; Consolidated Car Heating Company, Albany, N. Y.; Fairbanks, Morse & Co., Chicago, Ill.; Federal Manufacturing Company, Elyria, Ohio; Franklin Manufacturing Company, Franklin, Pa.; the General Pneumatic Tool Company, Montour Falls, N. Y.; the Gold Car Heating and Lighting Company, New York city, the Gould Coupler Company, Depew, N. Y.; the H. W. Johns-Manville Company, New York city; Manning, Maxwell & Moore, New York city; Metropolitan Injector Company, New York city; National Car Coupler Company, Chicago, Ill.; Norton Grinding Company, Worcester, Mass.; Rand Drill Company, New York city; Robins Conveying Belt Company, New York city; Safety Car Heating and Lighting Company, New York city; Westinghouse Air Brake Company, Pittsburg, Pa.; Yale & Towne Manufacturing Company, New York city.

The Action of Lightning and Lightning Conductors.

A lecture was delivered recently by Sir Oliver Lodge before the British Institute of Architects, upon "Lightning and Lightning Conductors," an abstract of which is given in the *English Mechanic and World of Science* for June 10. The electrically charged cloud was represented by a thin sheet of metal mounted on non-conducting standards, and charged from a suitable battery at pleasure. This was placed in a position sloping downward from front to back, so that the model lightning arresters could have their points brought nearer to or farther from the under surface of the cloud by shifting their positions on the table. The lecturer placed in operation successive conductors of copper, iron and wet string. When copper was used, the discharge took place with a sharp crack. With iron the discharge produced less noise, and with the wet string hardly any; yet the latter was efficient in protecting the other two conductors. Sir Oliver maintained that the iron was quite as efficient a conductor as copper for this purpose, and further, that, due to the intensity of action, copper was more likely to set up a side flash than iron, although the latter in protected buildings had been the cause of most lightning accidents. The lecturer illustrated and described his classification of lightning into A-flash and B-flash. The former is normally a discharge of lightning from an overcharged cloud direct to the earth; the B-flash occurs when a large cloud discharges into a smaller one, generally—though not necessarily—below it. The latter, thus suddenly overcharged, discharges to earth with great violence. This effect is illustrated, and it is pointed out that such discharges may be expected to be more sudden and intense than the A-flash, and proportionally more difficult to protect against.

New Station of the Commonwealth Electric Company.

The new station of the Commonwealth Electric Company, Chicago, Ill., is admirably located for its purpose. Some twenty-six acres of land were gradually secured by the president, Mr. Samuel Insull. This land is located on the west side, within a comparatively short distance from the centre of the city, and is surrounded on three sides by the water of the Chicago river, so that the coaling and other facilities are of the very best. The station itself is handsome in design and constructed with every possible modern feature. Three Curtis steam turbines, with a capacity of about 9,000 horse-power each, have been installed, two of which are now in constant use. President Insull is deservedly proud of the successful installation and operation of this modern plant.

THE ELECTRON THEORY.[1]

BY W. S. F.

Professor J. J. Thomson in the March number of the *Philosophical Magazine* discusses the theory of the stability of systems of electrons. His conclusion is that a number of electrons constitute a stable system when they are grouped in a series of concentric circular rings, very similar to Saturn's rings, which rotate about a common axis. Stability depends upon two conditions, namely, (*a*) upon a certain minimum angular velocity of rotation of a ring, and (*b*) upon the presence of at least $f(n)$ electrons at or near the centre of a ring containing n electrons. Stability increases when the angular velocity increases above the critical value and when the number of internal particles is greater than $f(n)$; $f(n)$ being a definite function of n.

The first part of Professor Thomson's paper is devoted to the establishment of the two conditions of stability (*a*) and (*b*) and the second part of the paper is devoted to the application of these results to the theory of the constitution of the atom. The features of the second part are:

1. A brief discussion of the types of oscillation of systems of electrons and the application of these results to the rationalization of spectra. Professor Thomson goes no farther than to show in a general way that the spectral lines of a given element may be grouped in a number of series of related lines, and that the different chemical elements of a group or family, such as the alkali metals, may have closely related series of lines. This same idea has been advanced by H. Nagaoka, of Tokyo, who promises soon to publish a paper devoted to this method of classifying spectra.

2. A full discussion of the relations between stable systems containing greater and greater numbers of electrons, and the application of these results to the rationalization of Mendeléef's periodic law. In this section of the paper Professor Thomson shows that a system of electrons furnishes a dynamic model which, with increasing numbers of electrons, exhibits properties closely analogous to those remarkable periodic variations of valency of the chemical elements with increasing atomic weight. This constitutes the first suggestion of anything worthy to be called a rational basis of Mendeléef's law, and its importance can scarcely be overestimated. It is, perhaps, the greatest contribution to theoretical physics during a decade. In this section of his paper Professor Thomson discusses the process of chemical combination in terms of his theory and he suggests an explanation of the catalytic action of water and of a metal such as platinum.

3. An application of the fact that the stability of a system of electrons depends upon a certain minimum angular velocity of the electron rings, to the explanation of radioactivity.

It is the purpose of this note merely to call attention to Professor Thomson's paper, which should be carefully read by every student of chemistry, and to give to the reader a sufficiently clear idea of the electron to enable him to fully appreciate Professor Thomson's theory of the structure of the atom.

It is not to be expected, of course, that a new hypothesis should lead at once to anything approaching a completely consistent theory, and it may be helpful to readers of Professor Thomson's article to point out the weak points of his theory.

The electron itself, although it has some very definite claims to objective existence, is not an entirely clear idea. The electric stress which radiates from an electron can, indeed, be thought of in mechanical terms, and the manner in which these lines of stress sweep through space when the electron moves, and the way in which they build up a magnetic field by their motion, can be thought of in a precise way, but no one has at present any definite idea of the nucleus of an electron nor of the way in which the nucleus moves. The mechanical analogue outlined below is misleading in this respect in being free from some of the essential difficulties which arise in the electrical case.

Professor Thomson's explanation of zero valency (which is exhibited by such elements as helium, neon, argon, etc.) does not appear quite satisfactory. He represents zero valency as an extremely evanescent and unstable case of monovalency.

I fail to see how, in Professor Thomson's theory, to explain the rise of valency of a given element by twos, for example the rise of valency of nitrogen from one to three to five. This mode of rise of valency has suggested to chemists the idea of the neutralization of valency bonds by each other in pairs. However, this difficulty may be met, perhaps, by using the notion of subsidiary groups of electrons.

On the other hand, Professor Thomson's hypothesis, that the atom consists of a number of extremely minute negative electrons moving about in a small spherical region containing uniformly distributed positive charge, meets a fundamental difficulty, namely, that experiment has hitherto failed to give any evidence of the existence of concentrated positive charges corresponding to the excessively concentrated negative charges which constitute cathode rays. In conformity with this hypothesis as to the structure of the atom, the mass of an atom is to be taken as proportional to the number of negative electrons the atom contains, regardless of the extent and value of the distributed positive charge. This is explained later in mechanical terms.

A clear idea of the behavior of a system of electrons depends upon an understanding of the dynamics of a single electron, and the dynamics of an electron is very different from the dynamics of a material particle.

The dynamics of an electron depend primarily upon the fact that kinetic energy is associated with a moving electric charge independently of the "material" mass of the body upon which the charge resides. That is to say, electric charge has inertia or mass. This association of kinetic energy with an electric charge is a phenomenon of the electric field, not of the charge itself, and the mode of association is precisely (not necessarily accurately) understood. Stated in terms of a mechanical analogue, it is as follows: imagine a great lake of jelly with a massless cylinder pressed down upon its surface. Underneath the cylinder the jelly will be under stress and strain, and this stress and strain will represent energy, corresponding to the purely electrical energy associated with the electrical stress surrounding a charged body. If this massless cylinder be rolled along over the jelly surface the strain figure underneath the cylinder will travel with the cylinder, and each successive portion of the jelly will move as it is twisted into conformity with the approaching strain figure, and as it is again twisted into its unstrained condition after the strain figure is passed. This motion represents kinetic energy corresponding to the magnetic energy of a moving electron, and the strain figure, therefore, has inertia.

If the cylinder is small in diameter the strain which is associated with it is greatly concentrated, and for a given integral amount of stress or strain (given force pushing the cylinder down) a much greater amount of kinetic energy would be associated with a given velocity of the rolling cylinder, inasmuch as the successive portions of the jelly would move with increased velocity as they are twisted into conformity with the approaching strain figure, and as they are again twisted into

[1] Reprinted from *Science*, June 10.

an unstrained condition after the strain figure has passed. Therefore, a strain figure having a given integral amount of strain has greater and greater inertia the more the strain figure is concentrated. At velocities which are low as compared with the velocity of wave propagation on the jelly surface the kinetic energy of the moving strain figure is proportional to the square of its velocity and, therefore, its inertia or mass value is constant. Where the velocity of the strain figure is not very small then the inertia reaction of the moving particles of jelly as they are twisted into and out of the moving strain figure helps to sustain or hold the strain of the moving figure. Thus at full wave velocity a strain figure is held wholly by this inertia reaction and no cylinder need be pressed upon the jelly to maintain a strain figure. On the other hand, when the cylinder is pushed down with given force the integral stress increases more and more with increasing velocity, a portion of the stress being sustained by the cylinder and a portion being sustained by the inertia reactions above mentioned. Therefore, with given force on the cylinder the integral stress approaches infinity as the velocity of the cylinder approaches the wave velocity, and corresponding to this increase of integral stress due to given force on cylinder the inertia or mass value of the strain figure increases indefinitely as its velocity approaches the wave velocity.

The inertia or mass value of a given electrical charge (integral value of electric strain) increases as the charge is more and more concentrated, and the inertia or mass value increases with velocity, approaching infinity at the velocity of light. In case of the moving electric charge, however, the increase of mass value due to magnetic reaction (corresponding to inertia reaction in the jelly) does not affect the integral value of the electric strain, but merely concentrates the electric strain more and more into a plane perpendicular to the direction of motion.

A clear picture in two dimensions of an electron may be obtained by imagining massless points to rest with a certain force against a horizontal stretched sheet of rubber, each point producing a deep, funnel-like depression. The mass value of each depression for given force pushing the point down is greater and greater the smaller the point.

This picture is, however, incomplete in several respects, notably in that two depressions (two negative charges) attract each other, while a depression and an elevation (a positive and a negative charge) repel. This is due to the essential differences between electric stress and any kind of mechanical stress.

A clear picture in two dimensions of a system of negative electrons moving about in a region of distributed positive charge —Professor Thomson's hypothetical atom —may be obtained by imagining a wide and shallow saucer-like depression in a rubber sheet in which a number of point depressions are moving about and held together as a system by the gradient of the saucer-like depression.

Such a system moving as a whole would owe its mass value chiefly to the concentrated point-like depressions, inasmuch as the broad and shallow saucer-like depression would have a negligible mass value, as explained above.

Some striking features of the dynamics of an electron are the following (see paper by M. Abraham, *Ann. der Physik*, January, 1903). These features depend partly upon the above-described increase of mass value of an electron with increasing velocity partly upon the slight delay between a given assumed change of velocity of the electron and the consequent rearrangement of the surrounding electromagnetic field, and partly upon the fact that an accelerated electron radiates energy in the form of waves like a steadily moving boat.

The mass value of an electron moving at given velocity as measured by the acceleration produced by a given impressed force varies with the direction of the force, being greatest in the direction of the motion (longitudinal mass) and least at right angles to the direction of the motion (transverse mass). Furthermore, the acceleration is in general not in the direction of the accelerating force; the relation between force and acceleration being represented by the relation between the diameter of a circle (sphere) and the corresponding radii vectores of an ellipse (ellipsoid) in the drawing which is ordinarily made by students to show the projection of a circle into an ellipse (a relation known as the linear-vector-function).

An electron moving uniformly in a circular orbit has acceleration and radiates energy so that its motion dies away. The dying away of the motion of a circular row or ring of electrons in this way is excessively slow if the number of electrons in the ring is great and if the velocity is small as compared with the velocity of light (see J. J. Thomson, *Phil. Mag.*, December, 1903). In fact, the time required for the angular velocity to fall from a value slightly above the critical value required for stability to the critical value might easily be a matter of millions of years under certain conditions.

It is interesting to note, although perhaps useless, considering the widespread confusion of the fundamental ideas of thermodynamics, that this electron theory, pointing as it does to finite systems which apparently never can settle to thermal equilibrium, suggests a class of phenomena, sensible and steady phenomena too, which are on the wrong side of thermodynamics, that is, on the side opposite to mechanics; phenomena which are to be treated by developing a systematic theory of atoms as isolated systems and the subsequent merging of this systematic theory of single atoms into a statistical treatment of aggregates of atoms; but this is another story.

Electrical Oscillations and Corresponding Voltage Rises.

A very clear and simple discussion of the cause of voltage rises on electrical transmission circuits containing inductance and capacity is here given by M. R. V. Picou. An expression is deduced for the voltage rise and an application is made to a system of which resistance, inductance and capacity of the various elements are known. The voltage rise under various conditions of opening and closing the circuit, and due to short-circuits, are computed. It is shown that, in some cases, this rise might be several times the maximum voltage of the circuit. The author believes that this rise is frequently the cause of the breaking down of insulators, with a resulting short-circuit, when the trouble is frequently attributed to a defective insulator. He points out the magnifying effect upon the harmonics of the generator, due to the capacity and inductance of the circuit, and shows that the rise in potential may be greater for overhead than for underground circuits, due to the smaller capacity of the former. This suggests that by increasing the capacity of a line by means of condensers, the danger due of voltage rise may be diminished. The paper concludes by giving methods of computing the capacity of various types of electrical circuits.—*Bulletin de la Société Internationale des Électriciens (Paris), May.*

Weather Reports by Telephone.

It is reported by the Cincinnati daily papers that the Cincinnati & Suburban Bell Telephone Company has arranged with the local weather bureau to receive the weather forecast on all weekdays. This will be sent promptly to all the neighboring exchanges, and any subscriber, by calling up his exchange, can obtain the report. It is anticipated that this service will be appreciated by the farmers, and that they will benefit thereby.

The New York State Independent Telephone Association.

Second Annual Convention, Buffalo, N. Y., June 23 and 24.

THE second annual meeting of the New York State Independent Telephone Association was held at Buffalo, at the Genesee Hotel, on June 23 and 24, and was well attended, there being upward of two hundred delegates and interested persons present.

Among the prominent telephone men present were the president of the association, Mr. George R. Fuller, of Rochester, who presided at the sessions of the convention; the vice-president, Mr. Howard Hendrickson, of Albany; secretary-treasurer, T. S. Lane, of Buffalo; Mr. B. G. Hubbell, of Buffalo; Mr. T. Harvey Ferris, of Utica; Mr. J. S. Brailey, Jr., of Wauseon, Ohio; Mr. F. M. Potter, of Syracuse; members of the executive committee, Messrs. Fisher, of Grand Rapids, Mich.; H. W. Blake, of Naples; A. M. Taylor, of Penn Yan; H. D. Critchfield, of Cleveland, Ohio; Elgood C. Lufkin and Charles B. Hill, of Buffalo; J. G. Splane, of Pittsburg; W. D. Barnard, of Philadelphia; Frank H. Mott, of Jamestown; A. L. Tetu, of Louisville, Ky.; W. L. Cary, of Cleveland; Warner, of Watertown; Wood, of Lowville; Otis, of Newburgh; Bernard, of Elmira; Griswold, of Albany; Kelley, of Newark; Brunson, of Geneva, and others.

The first session was held on the afternoon of June 23, President George R. Fuller occupying the chair. The proceedings began with an address of welcome to the delegates from Councilman Stoddard, speaking in behalf of the mayor of the city, who was absent in Chicago.

President Fuller replied on behalf of the association, thanking the councilman for his cordial welcome, and referring to the fact that there were not less than thirty independent telephone companies operating in this state, having headquarters at Buffalo, and that it was, therefore, peculiarly appropriate that the meeting should be held in that city. He proceeded to read a paper, which he had prepared, dealing generally with the history of the association and its development, and the advances made in independent telephony generally throughout the country, the statement being made in the course of the paper, that about seventy-five per cent of the cities of the United States have independent telephone companies, and those telephones are controlled by about 7,000 companies, and citing instances showing the growth of independent telephone companies in recent times. The report of the secretary, which consisted of the reading of the minutes of the last session, was next received, and the president then appointed the following committees:

Credentials—Mr. Johnston, of Buffalo; Mr. Warner, of Watertown; Mr. Potter, of Syracuse.

Membership—Mr. Calhoun, of Buffalo; Mr. Wood, of Lowville; Mr. Otis, of Newburgh.

Law, Legislation and Taxation—Messrs. Hendrickson, of Albany; Cary, of Buffalo; McDowell, of Elmira; Ferris, of Utica, and Bond, of Syracuse.

Nominating—Messrs. Bernard, of Elmira; Griswold, of Albany; Warner, of Watertown.

Auditing—Messrs. Kelley, of Newark; Brunson, of Geneva; Brailey, of Waterford.

The session resolved itself into an experience meeting and many delegates spoke of their experiences in various sections, organizing and installing independent telephones. Mr. B. G. Hubbell, connected with the Frontier Telephone Company, of Buffalo, was the first speaker. He spoke of the increasing business of the independent companies and the prospect of stronger and more profitable development.

Mr. Hubbell was followed by Mr. J. S. Brailey, of Wauseon, Ohio, who spoke of the desirability of having definite and binding contracts with companies with which long-distance connections were made. Mr. Ferris, of Utica, followed along in the same line, emphasizing the necessity of having proper written contracts in all such cases.

The president called upon Mr. E. B. Fisher, of Grand Rapids, Mich., to address the meeting. Mr. Fisher spoke, in part, as follows:

"The independent movement in the state of Michigan is in a very comfortable and satisfactory condition. The independent properties of the state, without exception, are prosperous. Some of them are growing even more rapidly than is convenient or comfortable for them, more rapidly than the stockholders and investors in them provide the money. In our state we have recently done one thing that I think perhaps is worthy of consideration in other localities. We have formed what we know as the Michigan Traffic Association, between the operating exchanges and toll companies in the state, to provide for a traffic committee of seven, and in the hands of that traffic committee is put the toll rate where a county is covered by two or more systems or lines, and this committee is a clearing house where settlements may be provided for. It provides for interchange of business and regulation of business, and also takes care to some extent of the question of permanency of toll-line connections. It is an alliance, offensive and defensive, and when the articles of incorporation of that traffic association are duly signed by the companies in our state in the independent telephone business, it will be well-nigh impossible for any company to break away from its allegiance to the independent movement and take its service out of the independent ranks. We have put in the hands of the traffic committee the regulation, within certain lines, of toll rates and of the methods of interchanging business, the conditions of business, the regulation of switching points, where several companies may be interested. We have been experimenting on this subject for some time in the state of Michigan. It is a matter that has been called to our attention very forcibly."

The president called upon Mr. H. W. Blake, of Naples, N. Y., in the central part of the state, for some of his experiences in that locality, and Mr. Blake complied by telling generally the story of the establishment of the independent systems in his locality, the difficulties they had had to encounter and the prosperous condition in which they now found themselves.

Mr. Taylor, of Penn Yan, was called upon, and spoke, in part, as follows: "Penn Yan is the county seat of the smallest county in the state of New York, and has a population of a little over 4,000, and to-day we have over 700 telephones connected up in Penn Yan, which I think is the best showing, according to population, of any place in the state of New York, and perhaps in the United States." He described the blackboard system of posting announcements and imparting information generally, which has been established at Penn Yan with success.

Mr. Charles B. Hill, of the Frontier Telephone Company, of Buffalo, invited

the delegates and others present to inspect the exchange of the Frontier company, and the session adjourned for that purpose, nearly every one present taking advantage of the opportunity to inspect the handsome and well-equipped exchange of the Frontier company, representing as it does the acme of development in modern telephony. The members and their friends were received at the Frontier building by officers of the company and conducted through the various departments, spending an interesting hour there.

In the evening a complimentary banquet at the Ellicott Club, Buffalo's downtown business club, was tendered to the visitors by the Inter-Ocean and Frontier companies. There were about 200 delegates and guests present. The decorations had one novel and appropriate feature, consisting of a desk telephone in the centre of each table, connected with red and green covered wires, festooned to four central points in the ceiling, and thence to the toastmaster's place at the head table. The dinner was thoroughly enjoyed by all. At the speaker's table B. G. Hubbell, of Buffalo, filled the rôle of toastmaster most acceptably. Beside him sat H. D. Critchfield, of Cleveland; George R. Fuller, of Rochester; Elgood C. Lufkin, Charles B. Hill, of Buffalo; E. B. Fisher, of Grand Rapids, Mich.; J. G. Splane, of Pittsburg; W. D. Banard, of Philadelphia; J. S. Brailey, of Wauseon, Ohio; Frank H. Mott, of Jamestown; A. L. Tetu, of Louisville, Ky.; W. L. Cary, of Cleveland. Speeches were made by James S. Brailey, E. B. Fisher, W. L. Cary, H. D. Critchfield, Frank H. Mott, J. G. Splane and A. L. Tetu, all of whom gave glowing accounts of the inauguration, growth and prospects of the independent telephone companies and movements in various sections of the country.

On Friday morning, June 24, the first thing on the programme was an inspection of the manufacturers' exhibits, of which there were many handsome and attractive ones, mostly in rooms on the same floor as the convention room, and which were visited to a greater or less extent all the time during the convention by interested persons.

At ten o'clock the president called the meeting to order and proceeded to receive the reports of committees. The executive committee reported several proposed amendments to the by-laws. The most important of the proposed changes and one that caused considerable debate, was whether or not the association should be composed of official representatives of independent telephone companies, one for each company, or of individual members. It was finally decided that all employés of independent telephone companies be admitted as associate members, with the right to vote on all questions. They are, however, to be denied the right to hold elective offices. The active members are to consist of representatives from each independent telephone company in the state.

The next business was the election of officers, and the following were elected: president, Henry H. Persons, of Buffalo, president of the Frontier Telephone Company, of Buffalo; first vice-president, Howard Hendrickson, of Albany; second vice-president, Boyd McDowell, of Elmira; treasurer, T. Harvey Ferris, of Utica; secretary, T. S. Lane, of Buffalo.

The executive committee: George R. Fuller, of Rochester; Henry H. Persons, of Buffalo; Edward Davis, of Philadelphia; C. H. Poole, of Utica; S. B. Rosser, of Elyria, Ohio; James S. Brailey, Jr., of Wauseon, Ohio; J. S. C. Edwards, of Johnstown; T. B. Basselin, of Groghan; F. M. Potter, of Syracuse; J. F. Stockwell, of Oswego.

President George R. Fuller, the retiring president, addressed the nembers present, thanking them for their loyal and hearty support during his administration, and voicing the appreciation of the association for the royal entertainment received at the hands of the Inter-Ocean and Frontier companies, while in Buffalo, and a rising vote of thanks was adopted and tendered to those companies for their kindness and hospitality.

As the newly elected president, Mr. Henry H. Persons, was prevented by illness from being present, the chair was taken by first Vice-President Hendrickson. The usual votes of thanks to the retiring officers were then brought before the meeting and unanimously adopted.

The president announced that the meeting was open for miscellaneous business and matters of general interest, and Mr. Snowden, of Jamestown, brought the following before the meeting, in regard to long-distance and toll-line connections:

"Be it resolved, that it is the sense of the New York State Independent Telephone Association that the territorial rights of any and all accredited companies, toll lines, or exchanges, shall be scrupulously respected, and that no independent company shall encroach on the rights of any other independent company."

The motion was duly seconded by Mr. Griswold, put to the meeting, and carried.

It was decided to dispense with the afternoon session and the papers that were to have been read at that session will be printed in pamphlet form and distributed to every member of the association. This was done so that the delegates could visit Niagara Falls. The titles of the papers and authors are as follows:

"Telephone Construction and Its Proper Care," W. H. Johnston, of Buffalo, N. Y.

"Methods of Exchange Operating and Its Relation to the Public," F. M. Potter, of Syracuse, N. Y.

"Methods of Handling Toll Business," T. S. Lane, of Buffalo, N. Y.

"Methods of Exchange Accounting," George R. Fuller, of Rochester, N. Y.

"Telephone Conditions in Great Britain and Continental Europe," M. S. Conner, of Rochester, N. Y.

The question of the place for holding the next convention will be decided by the executive committee.

The meeting then adjourned.

The British Institution of Electrical Engineers.

The May number of the *Journal of the British Institution of Electrical Engineers* contains the following papers, with the discussions: "Transatlantic Engineering Schools and Engineering," by R. Molineux Walmsley; "The Rated Speeds of Electric Motors as Affecting the Types to Be Employed," by H. M. Hobart; "The Railway Electrification Problem and Its Probable Cost for England and Wales," by F. F. Bennett; "Experiments on Eddy Currents," by W. M. Thornton; "Three-Phase Working, with Special Reference to the Dublin System," by W. Brew; "The Steam Turbine," by William Chilton; "Education of an Electrical Engineer," by Professor F. G. Bailey.

Persian Telegraphs.

A British consular report for last year describes the progress which has been made in the construction of the central Persian telegraph. This line is to supplement the Indo-European service, as the latter is burdened with an increased traffic. The new line branches from the old at Kashan. Work was commenced in December, 1902, at this point, and construction has been pushed rapidly, despite the climate and other difficulties, at the rate of fifteen miles per week. The line was laid to Yezd, a distance of 237 miles. It thence proceeds to Kerman, the rate of construction during this stretch being twenty miles per week. After reaching Bam, a single line joining the British frontier at Kuh-i-Malik-i-Sia was laid out. The new line gives a direct route from Persia to India. The old system followed two sides of a triangle.

Reviews of Current Engineering and Scientific Literature.

An Instrument Indicating Irregularity of Rotation.

An instrument for indicating irregularity of rotation of a revolving mechanism has been invented by Dr. P. Berkirtz. This consists of a flywheel attached loosely to the shaft, the motion of which is to be examined. On the periphery of this wheel a projecting cam is attached, and against the latter presses, by means of a spring, a light arm, held in a radial position by guides, and articulated at the centre of rotation to a mirror by means of a small lever. The guides holding this rod are attached to a sector, which is fixed rigidly to the shaft, and which also carries two springs tending to hold this sector and the flywheel in a relatively fixed position. Any angular variation between the sector and the discs causes the end of the rod mentioned above to travel along the cam, the curve of the latter causing the rod to move in and out. The effect of this is to rock the mirror through a small angle. A beam of light is allowed to fall upon the mirror, and is then deflected to a screen. If the rotation of the shaft is perfectly regular, this beam traces on the screen a circle, but if there is any irregularity of motion, this is indicated by a distortion of the circle, due to periodic shifting of the flywheel ahead and behind the sector attached to the shaft. The apparatus in this way gives a visual indication of the irregularity of rotation. Where a permanent record is desired, the light is allowed to fall upon a sensitized screen. —*Translated and abstracted from L'Industrie Electrique* (*Paris*), *June* 10.

Electric Conductivity of Solutions of Radium Bromide.

Considering the strange behavior of radium salts, it is well that the electric conductivity of solutions of radium bromide should be investigated. This has been done by Messrs. F. Kohlrausch and F. Henning, who found that the conductivity of radium bromide seems to conform closely to that of barium, to which radium appears to stand nearest. There is no evidence of hydrolysis; the bright platinum electrodes remain unaffected. The equivalent conductivity increased regularly when the solution was diluted from one-twentieth to one-twelve-thousandth normal. The temperature coefficient of conductivity was 0.024, which is what could be expected by analogy. Owing to the difficulty of obtaining pure radium salts, the determinations can not claim a very high degree of reliability, particularly as there is an uncertainty about the atomic weight. From spectroscopic evidence, Runge and Precht have concluded that the atomic weight of radium is 258. This will, of course, affect the determinations of conductivity which have been made, and bring radium near the monatomic metals. The determinations of Runge and Precht, as regards heat production by radium, agree well with the determinations of Thury, Laborde and others. They found last year that one gramme of radium developed 105 calories per hour. A more recent determination gave Precht a value of 98.8 calories. The lower atomic weight assumed by M. and Mme. Curie would bring this up to their own value, 113.3.—*Abstracted from Engineering* (*London*), *June* 10.

Electric Metal-Melting Furnaces.

Two types of electric melting furnaces, for use in chemical and metallurgical industries, have been developed by La Société Anonyme L'Industrie Verriére et ses Dérivés. In these furnaces the charge is included in the electric circuit as a heat resistance, by means of conductors embedded at different heights in the wall of the furnace. In order that the layer of the charge may vary in thickness, a number of these fixed leads are arranged one above another, so that they may be included in the circuit, according to the requirements. Air may be excluded from this furnace, since moving electrodes are not made use of. The gases set free are drawn off without mixing with air. The walls of the furnace are made of refractory material, and the conducting leads consist of rings, each ring being made of several pieces. This arrangement allows the current to be regulated and gives control of the heat developed. Thus, when putting the furnace into action, the material may offer a considerable resistance. The current is then passed through two sets of electrodes comparatively close together. As the charge becomes heated and the resistance decreases, the electrical connections are shifted to electrodes further and further apart, and in this way the current is kept at the proper value. When the molten material must be maintained in this state for a considerable time, to allow purification to take place, the lower part of the furnace consists of a crucible of refractory material which catches and retains the molten mass. This crucible is surrounded with conducting material, through which current may be passed, and the material thus maintained at any desired temperature.—*Abstracted from the Mechanical Engineer* (*London*), *June* 4.

The Dissociation of Copper Sulphate and the Decomposition of Copper Anodes.

In this article M. D. Tommasi gives an account of some experiments which he made some time ago, and which he thinks may account for certain phenomena observed in the decomposition of copper anodes. M. Tommasi found that upon boiling a solution of chemically pure copper sulphate this became cloudy; and upon letting it stand for a time, a pale green powder settled, which could only be basic sulphate of copper. The same effect was observed when a few crystals of copper sulphate were thrown into a litre of distilled water, while boiling. A quantitative determination showed that when fifteen grammes of copper sulphate were dissolved in 1,500 grammes of distilled water, and boiled for seven hours, 0.38 gramme of the basic sulphate was thrown down; but, upon further heating, there was no further deposition. To determine whether this basic sulphate would be dissolved if left in contact with the copper sulphate, a similar solution was prepared. After boiling for seven hours it was allowed to stand for three weeks. The quantity of basic sulphate found in this case was 0.356 gramme, a difference of 0.024 gramme from that found in the first experiment. Upon heating the solution used in the second experiment, 0.020 gramme of the basic sulphate was thrown down, thus bringing the total amount in agreement with that observed in the first case. M. Tommasi gives some tables showing the amount of basic sulphate formed with solutions of different strengths. The composition of the basic sulphate varies with the concentration of the solution, in general being the more basic the more concentrated the copper sulphate. From these experiments M. Tommasi thinks that the deposit observed on copper anodes during electrolysis may

be attributed to this basic sulphate.—*Translated and abstracted from L'Électricien (Paris), June 4.*

Why Use Carbon Brushes on the Modern Dynamo?

It is surprising—at least to Mr. J. W. Burleigh—that the carbon brush is still used on dynamos, in spite of the increased knowledge of dynamo design. This practically necessitates large commutators and extra expense of brush gear, large shafts and longer machines, and therefore must increase the cost of production by a large amount. Especially is this the case where large currents have to be dealt with. This practice results from the designer's doubt of the efficacy of metal brushes. Carbon brushes not only increase the first cost, but lower the efficiency, so that it frequently happens that this might be increased two or three per cent by the use of metal brushes. Consulting engineers demand carbon brushes, unmindful of the fact that so long as sparkless commutation is secured it is immaterial of what the brush be made. The author compares the design of a commutator for a six-pole eighty-eight-kilowatt parallel-wound armature for carbon and for metal brushes. He finds that the use of carbon necessitates three times as many brushes as the metal. For the former, the commutator must be seventeen inches long, and for the latter only six. The watts lost, due to the friction of the carbon brush, number 1,025, as against 205 for metal. The watts lost, due to the resistance of contact of the former, are 1,260, as against 434, making the total loss 2,285 watts for carbon, and 639 for metal. The watts lost per square inch are 2.51 for carbon, and two for metal. The commercial efficiency with the carbon brush is 91.8 per cent; with metal, 93.4 per cent. The chief virtue of the carbon brush is its high specific resistance, which facilitates sparkless commutation. To secure a similar condition with metal brushes, they may be subdivided with an insulating partition between the portions; or the central layers of metal may have a higher specific resistance. Where a reversible motor is employed, a radial brush is necessary, but it should not be impossible to construct a satisfactory brush of this type out of metal. Mr. Burleigh then takes into consideration the effect of pole shape upon commutation. He shows that a radial division of the pole is not always satisfactory, though better results might be obtained were the slot carried entirely through the pole and yoke. He then calls attention to a type of pole suggested by himself some years ago, in which, by means of magnetic shunts passing out of the area influenced by the armature winding, the magnetic potential of the two tips may be made nearly the same.—*Abstracted from the Electrical Review (London), June 10.*

The New Holborn, London, Telephone Exchange.

This article describes briefly the new equipment installed by the National Telephone Company in the Holborn exchange. The central battery has been adopted in its entirety, and some improvements and modifications have been made. One of these is the addition of three lamps next to the pilot lamp at each operator's position, for the purpose of assisting both the operating and supervision. The pilot lamp is connected up in the usual way, with the relays associated with it, so that it glows whenever one of the subscribers' call lamps lights up. Next to this is a red lamp, which lights up when the connection has been made to a junction line leading to an outer London exchange. This is to remind the operator to press the meter key twice instead of once, since a double rate is charged for outer London calls. On the right of this lamp is a green instruction circuit lamp, which is used when the monitor or manager wishes to question all the operators simultaneously. At each operator's position there is a key associated with this lamp, and when the lamp glows, this key is depressed and the operator's instrument is then connected to the instruction circuit. This action extinguishes the lamp, showing that the instruction call has been attended to. Connections to the operator's speaking set have been modified. Instead of the receiver being connected directly to the secondary of a small induction coil through the listening key, the winding of this coil is divided into two halves, each of 135 ohms' resistance, and one terminal of the receiver is connected to the middle point, while a supplementary resistance of 370 ohms is placed in series between the other terminal and one terminal of the induction coil. The primary of the induction coil on the transmitter is connected in a somewhat similar manner, the resistances in this case being eighteen ohms, eighteen ohms and fifty-five ohms. The object of this arrangement is to prevent the operator's own microphone from acting as a transmitter to her own receiver. It is practically a three-wire connection, so balanced that while the speech from the subscriber's line is audible in the receiver, no noise is transmitted from the operator's own microphone. A fourth lamp on the right is associated with the registers. If the operator's register is recorded properly, it closes an auxiliary circuit and lights this lamp. The registering key is pressed after every call, whether the subscriber is on a message or on unlimited service. —*Abstracted from the Electrician (London), June 10.*

Observations with Schlomilch's Wave Detector for Wireless Telegraphy.

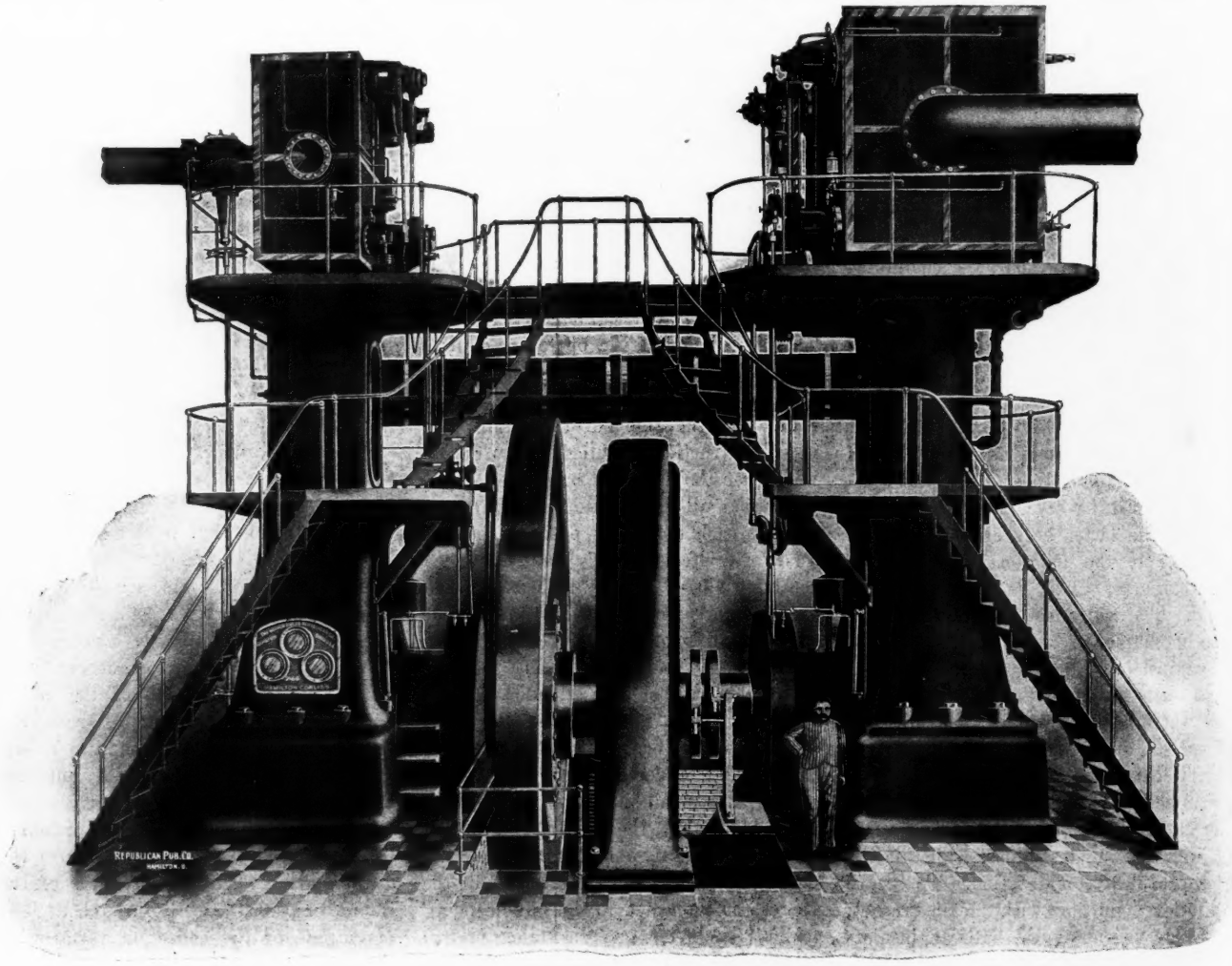
The wave detector devised the latter part of last year by Herr W. Schlömilch, consists of a very small electrolytic cell. This is constructed by sealing a piece of the finest obtainable platinum wire within a capillary tube; then softening the glass and drawing out the tube so as to reduce still further the cross-section of the wire. The tube, thus reduced, is then broken, and the exceedingly small surface of platinum wire exposed forms the electrodes of the cell. The electrolyte used is usually dilute sulphuric acid, and a very small current is passed through the apparatus. If this be connected in a circuit so that electric impulses are set up, due, for instance, to electric waves striking the antenna of a wireless telegraph system, the current passing through the cell is momentarily changed. This effect has been attributed by Fessenden to a bolometer action, but it seemed to Herr M. Reich that this action deserved further investigation. He accordingly set up one of Schlömilch's cells and passed through it non-oscillatory electric impulses obtained from a condenser. He found that the deflection of the galvanometer connected in circuit with the cell was small when the impulse passed in the direction of the current, but that the deflection was large when the impulse passed in the opposite direction—larger, in fact, than the deflection of the galvanometer when the discharge of the condenser passed directly through it. The magnitude of the deflection varies with the intensity of the discharge, and also with the value of the polarizing current, and for every wave intensity there is a definite polarizing current which will give the maximum deflection. Bringing the electrolyte of the cell to the boiling temperature did not put a stop to its action. These observations seem to the author to prove that the action of the cell is not similar to a bolometer, but is due to the effect of the waves upon the polarization of the electrodes.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), June 15.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Hamilton-Corliss Vertical Cross-Compound Engine.

The accompanying illustrations show the assembly and a few details of the new Hamilton-Corliss vertical cross-compound engine, built by the Hooven, Owens, Rentschler Company, Hamilton, Ohio. The engine shown is one which is being exhibited at the World's Fair, St. Louis, is 34 by 68 by 54 and direct-connected to a 1,500-kilowatt National Electric generator, a description of which was given in the ELECTRICAL REVIEW for May 7.



HAMILTON-CORLISS VERTICAL CROSS-COMPOUND ENGINE, DIRECT-CONNECTED TO 1,500-KILOWATT ALTERNATOR.

The engine has a normal rating of 2,500 horse-power. The cylinder sizes are, high-pressure cylinder, thirty-four inches diameter; low-pressure cylinder, sixty-eight inches diameter; stroke, fifty-four inches; speed, eighty-three revolutions per minute; main bearings, twenty-five inches diameter by forty-two inches long; shaft in wheel and generator, thirty inches diameter; crank pin, eleven inches diameter by eleven inches long; wheel, twenty-two feet diameter; weight, 120,000 pounds.

The engine is heavily built, strongly webbed and braced throughout the frame, with the best distribution of metal to meet the lines of strain and to produce rigidity.

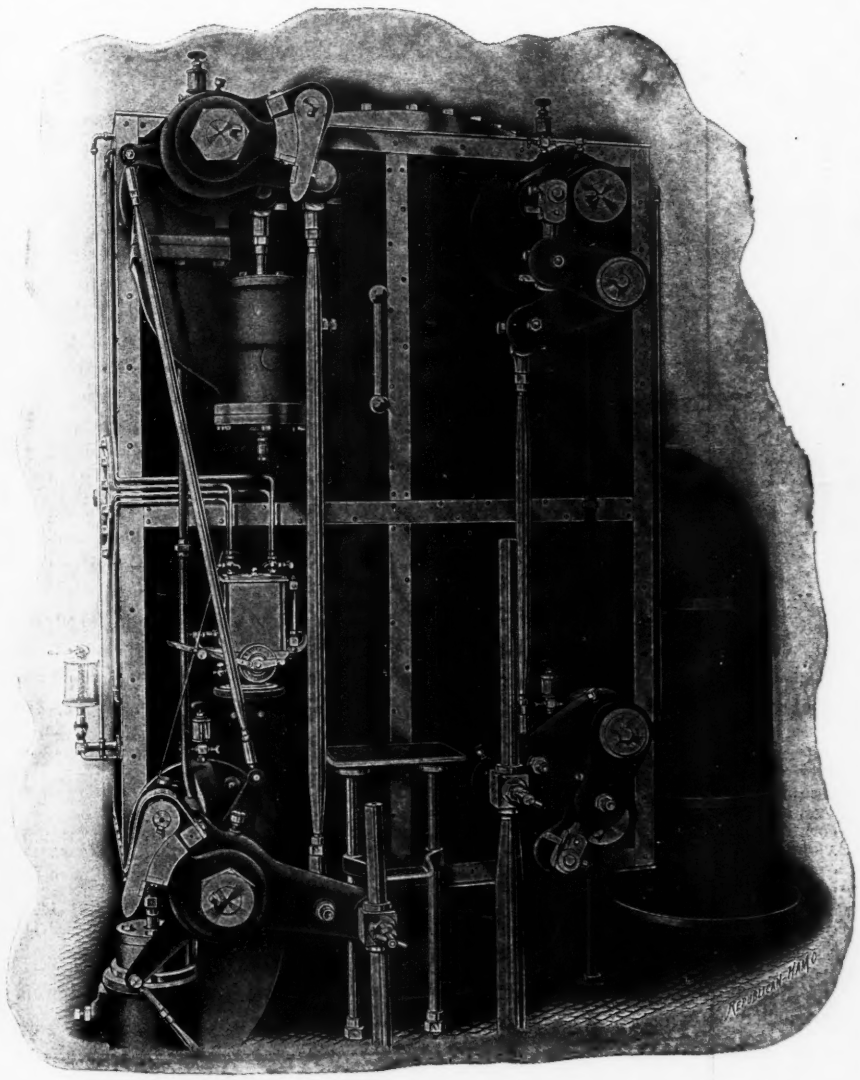
The bed-plate is of the box section type, deep, massive and strongly webbed, with liberal bearing surface on the foundation. It is cast in one piece and is carried around the crank at full height forming a deep crank pit to retain oil. This base has easy lines and well rounded corners. The main bearing portion is bored and faced to receive the bottom box which is of shell type so arranged that it can be removed by raising the shaft enough to remove the weight from the box. This box is arranged for water circulation.

The wheel is made in eight segments, a section of the rim and one arm to each segment. These segments are carefully planed and fitted at the joints and are bolted to the hub with turned steel bolts, holes being reamed for a driving fit. The rim is clamped together with steel arrow-headed links which are shrunk in place. The hub is in two separate discs forced upon the shaft. These discs are drilled, reamed and are bolted to the arms with turned steel bolts.

The "A" frame is cast in two pieces, strongly webbed, and is planed and fitted together and bolted with reamed fitting turned steel bolts. Its lower portion is of the box or rectangular section which gradually changes to a circular section as

it reaches the top, which gives very pleasing, but very strong lines. The openings on the sides are especially designed to receive oil shields which entirely enclose this part of the engine.

The guide barrel is circular in form, slightly flattened on the sides where the openings come, which are also designed for perfect fitting oil shields and doors. This portion of the frame is also strongly ducting covering. They are lagged with sheet steel with bright polished angle steel. The valves are located in the barrels to avoid the inconvenience of having to disconnect the valve gear when the heads are removed. This construction places the valves in such a manner as to reduce the clearance to about the same as if they were placed in the heads by bringing the exhaust valves partly within the



Low-Pressure Cylinder, Hamilton-Corliss Vertical Cross-Compound Engine.

webbed. The guides are separated from the walls of the barrel by an air space, and are bored from a common centre. The barrel is faced at both ends at the same setting which ensures perfect alignment.

The cylinders are made of close-grained charcoal iron as hard as is practical to machine them. The exhaust chambers are separated from the cylinder walls by an air space. The arrangement is such that there is a two-inch space between the cylinder walls and lagging for non-conducting covering. They are lagged with sheet steel with bright polished angle steel. The valves are located in the barrels to avoid the inconvenience of having to disconnect the valve gear when the heads are removed. This construction places the valves in such a manner as to reduce the clearance to about the same as if they were placed in the heads by bringing the exhaust valves partly within the cylinder walls, although at no time do the valves enter the space swept by the piston, while the piston is allowed to sweep past the ports. The arrangement is different on the steam valve side. The ports on this side are so arranged that the incoming steam strikes the piston squarely on the end thus preventing any side shock or pound common to the vertical type of engine. Both steam and exhaust valves are double ported and have a very short travel. The valves are cored and made as light as possible.

The pistons are cored and made as light as consistent with the proper factor of safety. They have a follower ring and one sectional ring which is pressed out by spiral springs held in place by tee-headed brass bolts. The pistons are forced on a taper and locked with a jamb nut and keeper.

The crosshead is of steel, with cast-iron slippers which are lined with best phosphor babbitt, peined in, bored and scraped to fit. Each slipper has a wedge adjustment which is entirely independent, hence the position of the slipper is not changed by its movement. The slippers are fastened to the crosshead by means of several steel bolts, relieving the wedge bolts of any extra strain and are so arranged that they can be easily removed. Their construction is such that it is impossible for them to get adrift. Piston rods are fastened to crosshead by thread, jamb nut and keeper.

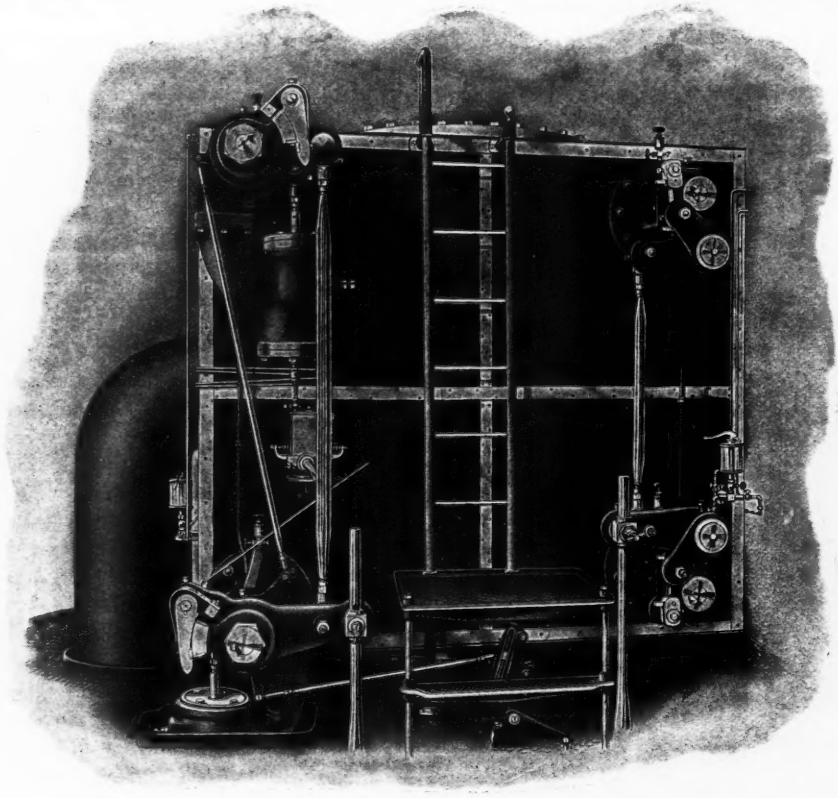
The connecting rod is of solid end pattern, five and one-half cranks long with wedge adjustment at either end, so arranged that in taking them up the length of the rod and clearance spaces remain constant. The boxes are of bronze, babbitted, peined, bored and scraped to fit.

The valve gear differs somewhat from the regular type. The steam and exhaust valves are actuated by separate eccentrics, direct, without wrist plates. The necessary motion is obtained by the use of levers and links on each bonnet separately, thus greatly reducing the strains. The dashpots are hung from the bonnets and are close to the cylinder, which make a very compact and self-contained arrangement, and are of the new noiseless pattern with the weight of the moving parts greatly decreased, and are adapted for much higher speeds than usual. Both steam and exhaust cam rods have efficient unhooking devices so that the valve gear can be worked by hand to facilitate starting and warming up. The valves are double ported with very short travel.

The dashpot levers are placed on the valve stems within the opening of the bonnet, hence are well supported on both sides to reduce wear. The releasing gear hooks and latch block trip plates have eight reversible wearing edges. All valve-gear connections are made to run as near noiseless as possible. The links have bronze connections with key adjustments. The weight of all reciprocating parts has been carefully proportioned so as to make the forces on the pins as uniform as possible.

The governor is of regular high-speed, centre-weighted, flyball type, with motor

and micrometer attachment for changing speed from switchboard to regulate for throwing in parallel. It is placed on the first gallery platform and is easily accessible. Both cylinders are under control of the governor, hence the work is properly divided to suit the load. The range of cut-off is from zero to three-quarters stroke.



HIGH-PRESSURE CYLINDER, HAMILTON-CORLISS VERTICAL CROSS-COMPOUND ENGINE.

The intermediate rocker arm supports for eccentric rods are of the box section strongly bolted to the guide barrel and are reenforced by braces from the "A" frame.

The main bearings are lubricated by a continuous stream of oil, which is furnished by an oil pump driven from the eccentric. The oil is pumped from a tank, which is located beneath the floor, to two receivers, which are located over each main bearing cap. From here it flows by gravity to all parts of the journal. The bottom box of these journals is cored out and arranged for water circulation. The eccentrics, crosshead slippers, crosshead and crank pins are oiled from a gravity feed system by multiple sight-feed tanks located on the upper part of the engine. The crosshead slippers have wipers on the bottom end, which dip into reservoirs at the bottom end of stroke, ensuring perfect lubrication of the guides. All the valve gears, rocker arms, etc., are lubricated by grease cups. The engine is thoroughly furnished with oil guards and shields to prevent oil from being thrown on the floor. The eccentrics are entirely enclosed to prevent oil creeping along the shaft and coming in contact with the wheel and generator.

The arrangement of stairways, galleries and platforms is such as to make all parts of the engine accessible, and are nicely set off with brass hand railway and polished stanchions. The platforms have special ribbing to prevent slipping, and are strongly supported to prevent vibration.

A Recent Brake Test of a 400-Kilowatt Westinghouse-Parsons Steam Turbine.

A brake test of a 400-kilowatt Westinghouse-Parsons steam turbine was carried out during the latter part of last year at the shops of the Westinghouse Machine Company, East Pittsburg, Pa., by Messrs. Dean and Main, consulting engineers of Boston, Mass., and the following is an abstract of their report:

The turbine was direct-connected to an alternating-current generator, but for the purpose of the test the latter machine was removed and a water brake substituted, the brake shaft being coupled to the turbine shaft. The turbine was connected to a surface condenser with the necessary pumps, and arrangements made for weighing accurately the water used. The tests were subdivided into ten-minute intervals. The duration of the full-load tests at 100 degrees superheat was two hours, and for most of the others, one hour. As a test of the accuracy of the measurements, it was found that the weight of water collected during the ten-minute intervals varied but little during any one load.

Tests were run for about one-third overload, full-load, three-quarters load and forty per cent load, for different conditions of steam and vacuum. The following table gives the results of the tests with 100 degrees Fahrenheit superheat:

	31 per Cent Overload.	Full Load.	77 per Cent Load.	41 per Cent Load.
Duration of test, hours	1	2	1	1
Revolutions per minute	3457.6	3546.5	3580.1	3588.7
Work done by brake-horse-power	758.9	594.6	445.3	239.9
Average steam pressure near throttle, pounds	150	156	154	153
Average superheat near throttle	104° F.	109° F.	104° F.	87° F.
Weight of steam per hour per brake-horse-power, pounds	12.07	12.41	12.86	14.62
Average vacuum in exhaust, inches	27.10	27.06	27.10	27.10

The following results were obtained with approximately 180 degrees Fahrenheit superheat:

	32 per Cent Overload.	Full Load.
Duration of test, hours	1	1
Revolutions per minute	3477.2	3542.7
Work done by brake-horse-power	762.6	532.3
Average steam near throttle, pounds	151	154
Average superheat of steam near throttle	182° F.	181° F.
Average weight of steam per brake-horse-power per hour	11.17	11.45
Vacuum in exhaust pipe, inches	27.00	27.10

With saturated steam, with a pressure of approximately 150 pounds at the throttle, the steam used per hour per brake-horse-power was 13.63 pounds for twenty-six per cent overload or 728.4 horse-power; 13.91 pounds for a load of 593 horse-power; 14.48 pounds for a load

of 448 horse-power and 16.06 for a load of 241 horse-power. During these tests the vacuum was approximately twenty-seven inches. With dry steam and a vacuum of only 25.91 inches, the consumption of steam per brake-horse-power-hour was 14.35 pounds for a load of 593.1 horse-power.

From the tests with superheated steam at about 100 degrees, it will be seen that, taking the speed at full load as normal, the variation in speed with an overload of thirty-one per cent was 2.5 per cent below normal. With a load of seventy-seven per cent, it was 0.9 per cent above, and for a load of forty-one per cent it was 1.2 per cent above normal. The sum of the extremes gives a variation in speed of 3.7 per cent. Tests with dry steam under the conditions given show an extreme variation in speed of 3.4 per cent.

The tests with superheated steam show that the saving of steam is about one per cent for every ten degrees of superheat within the limits employed during the tests.

To determine the thermal efficiency of the turbine, in order that it may be compared in this respect with the reciprocating engine, an assumption of the internal losses must be made. It is difficult to determine what these losses are, but, as it is becoming customary to allow six per cent for the internal losses of the reciprocating engine, the same allowance was made here, and it was thought that this is not too favorable to the turbine. Making this allowance, the following results are obtained:

	Dry Steam.	109° Superheat.	181° Superheat.
Rated load, brake-horse-power	593.17	594.60	592.27
Internal steam, horse-power	631.03	632.55	630.07
Total steam used per hour, pounds	8249	7384	6779
Absolute steam pressure	168.57	169.98	167.84
Temperature of condensed steam	95.3	95.8	94.7
Heat utilized by turbine per pound, British thermal units	1130.8	1182.8	1218.1
Thermal efficiency	17.22°	18.43	19.43

Comparing these results with similar percentages from reciprocating engines, it is seen that they stand in the front rank, and have seldom been surpassed.

Transactions of the American Institute of Electrical Engineers.

Volume xx of the transactions of the American Institute of Electrical Engineers, covering the work of the Institute from July 1 to December 31, 1902, is being distributed. This volume contains the papers read upon the following subjects: photometry and illumination, variable-speed motor control, braking and traction brakes.

The Indian Textile Journal Diary and Reference Book for 1904.

The Indian Textile Journal Company, Ltd., Bombay, India, has issued a diary and reference book for 1904. This book contains useful information in connection with cotton mills in India and Japan; information for mill agents, managers, engineers and others; much valuable information in connection with Indian and British patents, and rules relating to certificates and examinations of mechanical engineers in India.

The Western Headquarters of the Stanley Electric Manufacturing Company.

The accompanying illustration shows the exterior of the handsome headquarters of the Stanley Electric Manufacturing Company, at San Francisco, Cal. The entrance is on the corner and on a level with the sidewalk. The location is 69-75 New Montgomery street, diagonally across from the Palace Hotel. Mr. F. V. Lee is the efficient Pacific Coast manager of the Stanley company, in charge of these offices. The place is a prominent attraction for all engineering visitors to the Pacific Coast.

San Francisco, Cal., Headquarters of the Stanley Electric Manufacturing Company.

The Curtis Steam Turbine.

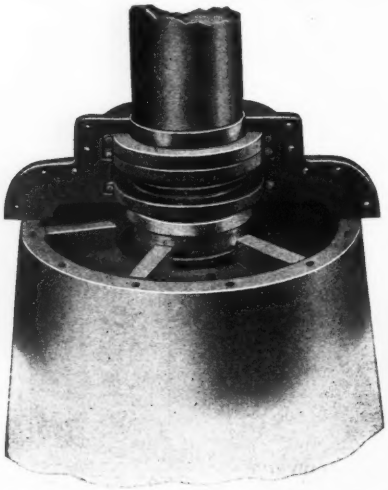
So much has been written about the design and operation of the Curtis steam turbine that its principles are generally well known. In presenting the accompanying illustrations, which throw a deal of light on the matter of design, details are omitted and only some of the more prominent characteristics will be pointed out.

The principle of this turbine permits the use of moderate rotative speeds, and compact and simple mechanism. The turbine is divided into stages, each of which may contain one, two, or more revolving buckets supplied with steam from a set of expansion nozzles. The work is divided between several stages, consequently the nozzle velocity in each stage is reduced. Under this arrangement the energy of the moving steam is effectively given up to the revolving part. The division of pressure between the stages is so arranged as to utilize the largest possible proportion of the energy of expansion.

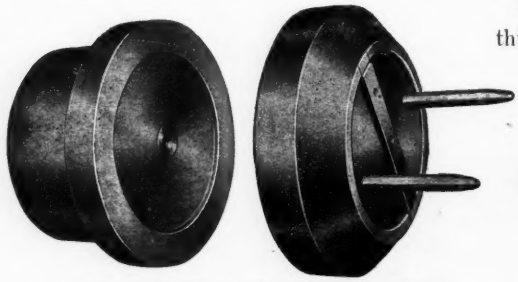
For turbines of large capacity the General Electric Company has applied these principles to the development of a turbine with a vertical shaft. All imposition of weight on cylindrical bearings and tendency to shaft deflection are avoided, as well as all difficulties due to irregularity of expansion or imperfections of support.

The step-bearing at the end of the vertical shaft supports the weight of the revolving part and maintains the revolving and stationary elements in exact relation. It consists of two cylindrical

cast-iron plates bearing upon each other and with a central recess to receive the lubricating fluid, which is forced in by steam or electrically driven pumps with a pressure sufficient to sustain the weight of the revolving part. It is apparent that the entire weight of the machine is thus carried on a film of lubricating fluid and that there is no appreciable friction. When the flow of liquid is interrupted the bearing is slowly worn away, but experience has shown that interruptions in the flow seldom cause any deterioration which prevents the continuance of the machine in service after the flow is re-established. The tendency of the bearing in such cases is to wear itself to a new surface so that it operates normally. In consequence of the relation maintained between the revolving and stationary elements by the step-bearing, it is possible to operate the turbines with small clearances between the moving and stationary buckets.



STEP-BEARING, SHOWING PACKING RINGS.

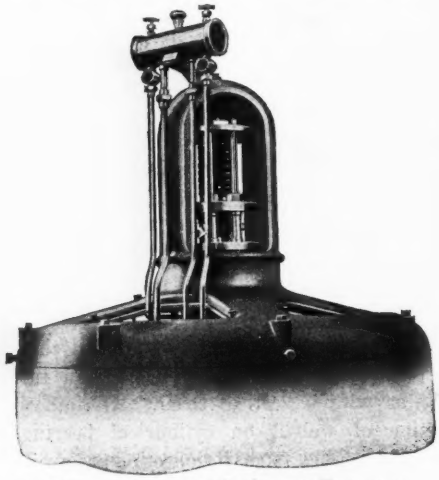


BEARING SURFACES IN STEP-BEARING.

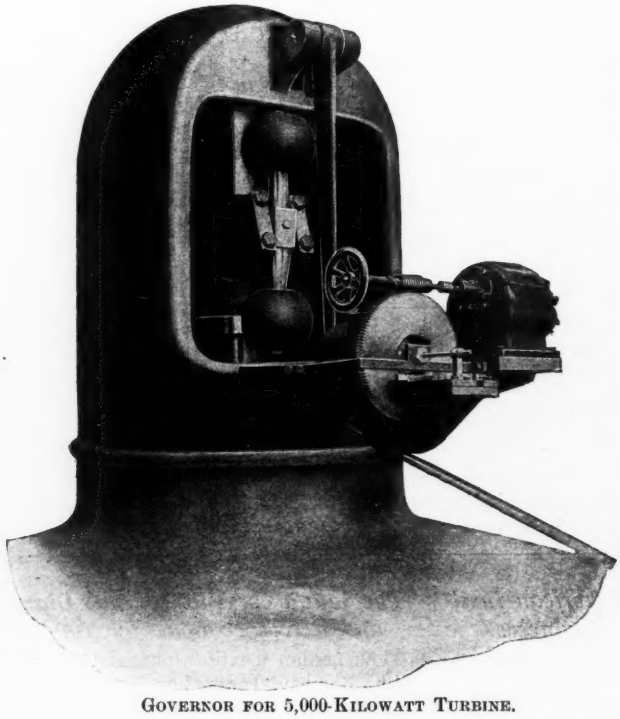
NOZZLE.

The Curtis turbine is governed by changing the number of nozzle sections in flow, and the efficiency of the machine is therefore about the same under one condition of load as another, except that friction, windage, and generator losses tend to slightly reduce the light load efficiency. Consequently, the efficiency of these turbines at light load is high, and with high overloads turbines of the Curtis type are operated without by-passing steam and without loss of efficiency. The generators to be operated with the turbines are designed for large overloads and the units are thus suited to effective operation under a very wide range of conditions.

The speed of these turbines with variable load is controlled by the automatic opening and closing of the original admission nozzle sections, the number of nozzle sections corresponding to the load always being kept in flow. A centrifugal governor attached to the top of the shaft imparts motion to levers which in turn work the valve mechanism. There are a number of valves, each communicating with a single nozzle section, or in some cases two or more nozzle sections. These valves are connected to long pistons, by which the valve can be opened or closed by steam. The motion of each of these pistons is controlled by a small pilot valve which is worked by the governor mechanism. The movement of the governor mechanism moves the pilot valves successively and the main valves are opened or closed by the steam. The mechanism is simple and durable in its character, and imposes a light mechanical strain upon the centrifugal governor. By suitable adjustment, almost any degree of accuracy in speed control is obtainable.



GOVERNOR FOR 500-KILOWATT TURBINE.



GOVERNOR FOR 5,000-KILOWATT TURBINE.

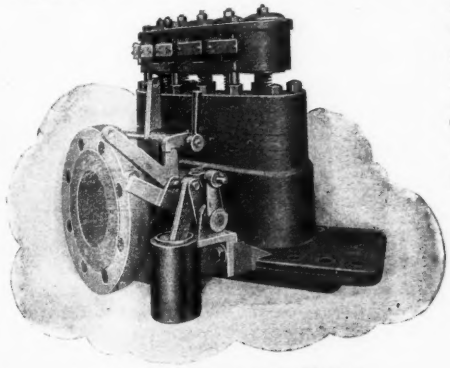
The steam consumption of turbines of this type is dependent upon speed, size, and other conditions, and varies in different individual designs. Machines of this type, which have been tested, show excellent results. The guarantees of steam economy made by the General Electric Company are conservatively based upon results obtained with machines in operation.

The larger sizes of Curtis turbines are designed to operate condensing, but they are all adapted to operate non-condensing, and when operating non-condensing will carry full-rated load. These turbines are designed to utilize the expansion of the steam to a high degree of vacuum, and the use of good condensing facilities is therefore desirable.

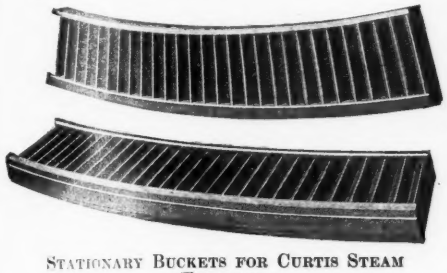
Some of the Curtis turbines have been developed with surface condensers forming the base of the turbine structure. This arrangement is very compact and convenient.

In the operation of these turbines the steam is expanded to a considerable degree before it reaches the first buckets. High temperature in the steam is therefore not a source of practical difficulty,

and steam of very high pressure and high degree of superheat can be used. The reduction in steam consumption by superheat or increased pressure is stated to be as great in the Curtis turbine as in any form of steam engine.



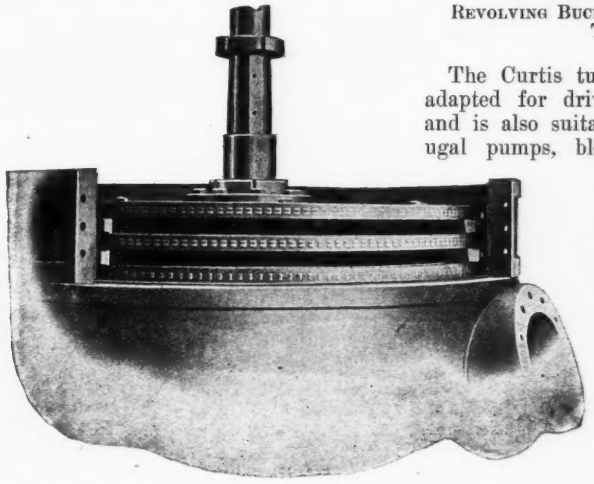
Electrically Operated Valve.



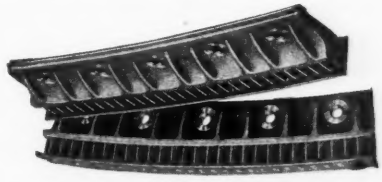
Stationary Buckets for Curtis Steam Turbine.

The question is sometimes raised as to the rate of deterioration through erosion of the buckets in the Curtis steam turbine. The General Electric Company has carried on experiments over a period of years with a view of ascertaining what the extent of this erosion might be. The result of these experiments has shown conclusively that while the wear varies with different degrees of moisture in the steam and with different degrees of steam pressure, it is in any event negligible from the standpoint of maintenance. All buckets in the Curtis turbine can be renewed without difficulty and at small expense. In the lower pressure stages, where the density of steam is less, no wear has been perceptible.

The speeds adopted for the Curtis turbines are such as to give the best results in the design of the generators; consequently the General Electric generators designed for operation with turbines have the highest efficiency and the best electrical constants, and are so proportioned that they will carry heavy overloads without injurious heating. The General Electric Company is building turbines ranging in capacity from one and one-half kilowatts to 5,000 kilowatts.

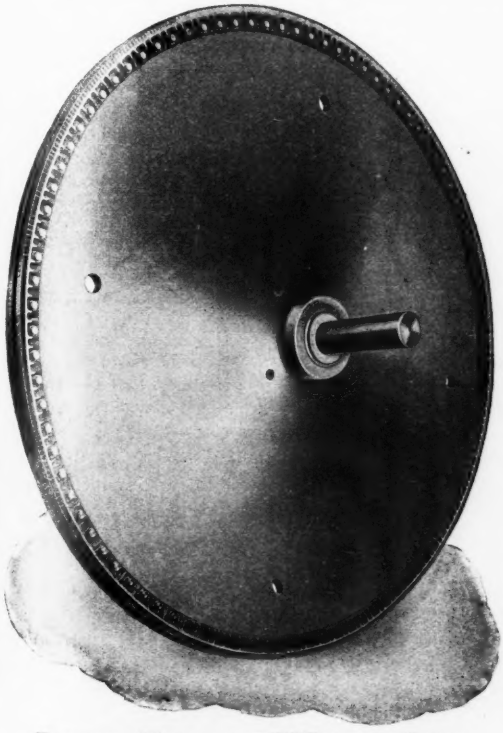


500-Kilowatt Curtis Steam Turbine in Course of Construction.

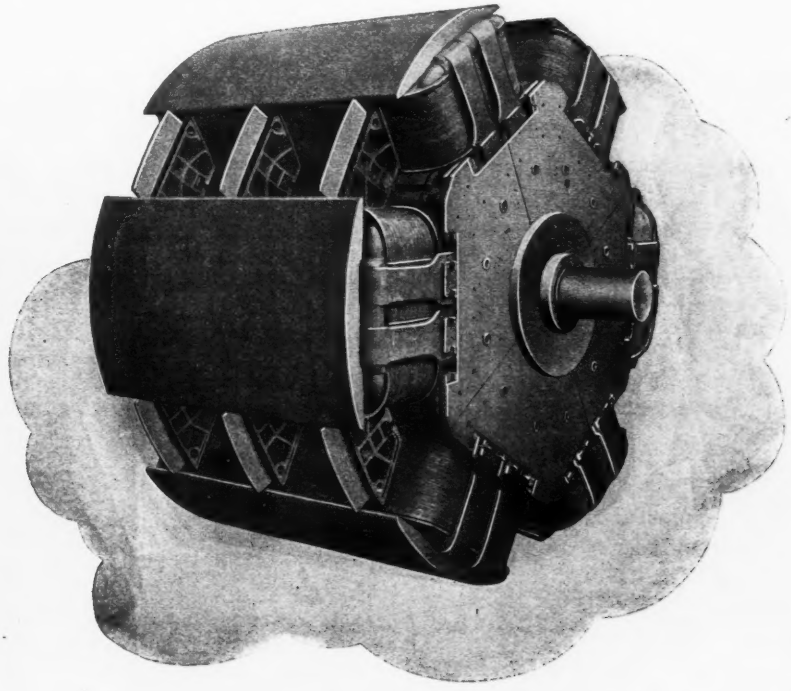


Revolving Buckets for Curtis Steam Turbine.

The Curtis turbine is especially well adapted for driving electric generators and is also suitable for driving centrifugal pumps, blowers, fans and other similar apparatus. Turbines for such applications are being rapidly developed and will soon be available. In order to meet the demand for small direct-current turbines to be used for exciters, train lighting and isolated lighting, a complete line of horizontal-shaft turbines has been developed, ranging from one and one-half kilowatts to 300 kilowatts. These machines are designed to operate at low shaft speed without the use of gearing and show relatively high steam economy when operating non-condensing. They are self-contained and are automatic in regulation.



Revolving Wheel for 2,000-Kilowatt Curtis Steam Turbine.



Revolving Field for a 5,000-Kilowatt Alternating-Current Turbine-Generator.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

SOUTHERN RAILWAY CONSOLIDATION—The Southern Electrical Securities Company has been incorporated under the laws of the state of New Jersey with a capital of $1,000,000 and with $1,600,000 of bonds. This company has absorbed the Beaumont Traction Company, the Southern Light and Traction Company, of Natchez, the Jennings Electric Light and Power Company and the Vicksburg Railway and Light Company.

LONG-DISTANCE TROLLEY LINE FOR GEORGIA—A trolley line has been projected from Atlanta, Ga., to Anderson, S. C., and the proposed route is now being surveyed. The line will be 140 miles long, and will connect at Anderson with the trolley line from Greenville, making the whole line 165 miles in length. The line, as now proposed, will extend from Atlanta to or near Stone Mountain, Lawrenceville, Hoschton, Jefferson, Commerce and Carbesville, in Georgia, and thence to Anderson.

MEXICAN ELECTRICAL NOTES—The formation of a syndicate for the purpose of constructing a system of electric railways in and about Parral, state of Chihuahua, is progressing satisfactorily. This syndicate proposes to build and operate, in addition to the railway, a system of telephones in the state of Chihuahua. This system will connect the principal mining camps and the agricultural and cattle regions with the capital of the state. An electrical power plant and electric tramway system will be constructed at the Barranca del Oro mines, situated at Ixtlan, territory of Tepic, Mexico.

INCREASE IN THE CAPITAL OF THE NIAGARA, LOCKPORT & ONTARIO POWER COMPANY—At a meeting of the directors of the Niagara, Lockport & Ontario Power Company, held on June 18, it was voted to increase the capital stock from $1,000,000 to $10,000,000, for the construction of the power canal from the Niagara river, under a state charter which was granted ten years ago. Mr. Stephen S. Palmer, of New York, was elected a director in place of Thomas Oliver, resigned, and Judge Charles Hickey, of Lockport, was elected a director in place of Charles J. Perrin, of Lockport, resigned.

CHANGE OF OWNERSHIP OF MUNCIE (IND.) LIGHTING PLANT—The Electric Company of America, the headquarters of which is at Philadelphia, Pa., has purchased the entire holdings of the Muncie Electric Light and Steam Heating Company. It is understood that extensive improvements have been planned. The Electric Company of America is said to be negotiating for the purchase of the entire holdings of the Muncie, Hartford & Fort Wayne Interurban Railway Company. As this company controls the lighting plant at Marion, Ind., it is thought that if the proposed deal is closed the power plant of the traction company at Eaton will be enlarged and used to supply the needs of both cities.

PENNSYLVANIA TUNNEL CONTRACT GIVEN OUT—The New York Contracting and Trucking Company has been awarded the contract for excavating the site of the Pennsylvania Railroad terminal in New York city by the directors of the Pennsylvania, New York & Long Island Railroad Company. It is reported that the amount of the contract was $5,000,000. Mr. R. G. Collins, chief engineer of the New York Contracting and Trucking Company, will have charge of the undertaking. The excavation is to be dug or blasted out to a uniform depth of forty feet. One-third of the operations will be through solid rock. The New York Contracting and Trucking Company was incorporated in New York city in May, 1900, with a capital of $10,000. James E. Gaffney was its first president.

SUBWAY COMPANY WINS IN SUIT WITH CITY—Justice Scott, in the Supreme Court, has sustained the demurrer interposed by the Empire City Subway Company to the suit brought by the city of New York against it and the Consolidated Telegraph and Electrical Subway Company, to compel them to give a correct accounting of the capital invested and of their net earnings. The franchises of these companies require them to pay to the city all net earnings in excess of ten per cent of the cost of construction. It was alleged by the city that the companies had avoided making these payments by incorrect reports. The counsel for the companies demurred, on the ground that the complaint did not contain facts, but simply conclusions, and Justice Scott held that the complaint was insufficient.

CONSOLIDATION OF IDAHO POWER COMPANIES—A new corporation has been organized in Idaho with a capital of $2,000,000. This is the consolidation of the Bonanza Land, Power and Light Company and the American Falls Power, Land and Light Company with the Tarbet power interests of that vicinity. The name of the new company will be the Idaho Consolidated Power Company. It has been incorporated under the laws of Wyoming. In addition to the properties named, the company also takes over the interests of the Blackfoot Light and Water Company and the Rexburg Light and Power Company. The officers are A. H. Tarbet, of Salt Lake City, president; J. H. Brady, of Pocatello, general manager; D. W. Stanrod, of Pocatello, treasurer, and W. S. Chaney, secretary. The company derives its power at American Falls, Ida. It is intended to run a pole line to Butte, Mont. The present plant at American Falls will be enlarged and many improvements made.

GOVERNMENT WIRELESS SERVICE—It is announced that a contract has been signed by the United States government, at Washington, with the De Forest Wireless Telegraph Company, providing for an extensive wireless service. The terms of the contract give the government the right to make full use of the De Forest system, and the government pays for the installation of stations and equipment. The company reserves the right to send all private and commercial messages over these lines. The contract accomplishes the plan of wireless communication from New England to Panama, and it is expected, will make it possible to communicate, within a short time, from New York to the Orient. Stations will be erected connecting the naval bases in Key West, Fla., Guantanamo and Culebra, Cuba, and Panama. A station will be placed in lower California, to connect with San Francisco, which will connect with Seattle. One of the largest stations is being operated at Dutch Harbor, in the Aleutian Islands, and this will be placed in communication with a station at Kamchatka, Japan. The contract was entered into by Rear-Admiral Manney, chief of the naval bureau of equipment, and Abraham White, president of the American De Forest Wireless Telegraph Company. The company is to supply to the government the wireless instruments, and guarantees to maintain reliable service on the following circuits: Key West to Panama, 1,000 miles; Porto Rico to Key West, 1,000 miles; south Cuban coast to Panama, 720 miles; Pensacola to Key West, 450 miles; south Cuba to Porto Rico, 600 miles.

PERSONAL MENTION.

MR. O. FINNIS has resigned as superintendent of the electric light plant at Grand Rapids, Minn., to accept a position at Hibbing, Minn.

MR. FREDERICK PARKER, who is a brother of Justice Alton B. Parker, has been appointed secretary of the Mineola, Port Washington & Roslyn Traction Company, Mineola, L. I.

PROFESSOR W. F. M. GOSS, M. Am. Soc. M. E., and dean of the School of Engineering, of Purdue University, recently received from the University of Illinois the honorary degree of doctor of engineering.

MR. S. P. GRACE, chief engineer of the Central District and Printing Telegraph Company, Pittsburg, Pa., had the honorary degree of "Master of Engineering" conferred on him recently by the State University of Michigan.

MR. E. F. PHILLIPS, of the Edison Electric Illuminating Company, Detroit, Mich., was elected president recently of the Michigan Association of Electric Light Managers, which was organized May 7 at Detroit. Mr. F. S. Hubbell was elected secretary.

MR. EDWARD E. GOUDEY, vice-president and general manager of the Goudey-McLean Company, has resigned to associate himself

with the firm of B. F. Bell & Company, consulting engineers, 220 Broadway, New York city, N. Y. Mr. Goudey retains his interests in and remains vice-president of the Goudey-McLean Company.

PROFESSOR A. MARSTON, who was in charge of the civil engineering department of the Iowa State College, Ames, Iowa, for a number of years past, was recently elected dean of the engineering division of the college. Professor G. W. Bissell has charge of the department of mechanical engineering and Professor L. B. Spinney has charge of the department of electrical engineering.

MR. T. T. LYMAN, chairman of the executive committee of the New York League of Heat and Cold Insulation, and manager of the asbestos department of the H. W. Johns-Manville Company, New York city, N. Y., was tendered a silver loving service at the first annual dinner of the league held recently in the dining-rooms of the Building Trade Employers' Association, Manhattan. The service was as a token of the high esteem and regard in which he is held by his fellow members for his efforts in their behalf. The service was composed of a silver loving cup eighteen inches high, capacity of five quarts, resting on a silver tray twenty inches in diameter, with one dozen silver cups encircling the tray around the cup, which bore the following inscription: "Presented by the New York League of Heat and Cold Insulation to Thomas T. Lyman in recognition of his loyalty to our cause. 1903-1904."

MR. WALTER H. WHITESIDE has been appointed general manager of sales for the Allis-Chalmers Company. The new management of the Allis-Chalmers Company is acquiring the services of some of the ablest men in their respective lines in the country. Until quite recently Mr. Whiteside occupied an important position in the Westinghouse organization. He was manager of the supply department of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and general manager of the Sawyer-Man Electric Company, of New York city. Mr. Whiteside's experience, however, has not been confined to the electrical field. In 1881 he entered the employment of the Hercules Powder Company, the high explosive or dynamite branch of the Dupont Powder Company, of Wilmington, Del. He introduced its high explosive products into the Lake Superior regions, including the Calumet and Hecla mines and other mining districts. Four years later he became associated with the Cleveland Electrical Manufacturing Company, of Cleveland, Ohio. He was with this company for nearly twelve years. During the first two years he served in various capacities, and the remainder of the time was manager of the Chicago office. Mr. Whiteside was appointed manager of engine sales for the Gates Iron Works, of Chicago, in 1896. He was made manager of the Washington office of the Westinghouse Electric and Manufacturing Company in 1898. In this position he became associated with some of the largest electrical projects undertaken in the district which his office covered. He has been widely recognized for his engineering work in connection with the installation of electrical power in the drydocks of the navy department, especially the docks at Portsmouth, League Island and Boston. He was largely responsible for effecting the change in voltage standardization from 80 to 125 volts in electric lighting and power installations on board vessels of the United States Navy. Probably his best work in a commercial sense was in connection with his services with the detail and supply department of the Westinghouse Electric and Manufacturing Company. About a year ago he was appointed general manager of the Sawyer-Man Electric Company, of New York, at the same time continuing as manager of the detail and supply department of the parent company at Pittsburg. While Mr. Whiteside is a man of great commercial ability, he is very popular and possesses a delightful personality. He enters upon his new duties about the middle of July. His position will be that of general manager of sales for all departments of the Allis-Chalmers Company, including the Bullock Electric Manufacturing Company, which has become the electrical department of the Allis-Chalmers Company. His experience thoroughly qualifies him for this important duty, and he is the recipient of the good wishes of a very wide circle of business acquaintances.

MR. WALTER H. WHITESIDE.

ELECTRICAL SECURITIES.

Following the procedure of a week ago, there was a leisurely improvement in the condition of the stock market. While the dealings were not extremely active, the gains were general and extended to good proportions. The general sentiment is that conditions will improve, and the favorable weather conditions still continue a key to the market outlook. It is significant that a number of large operators who, up to a few weeks ago, were on the side depressing the market, have now turned about and are looking and working for higher values.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 25.

New York:	*Closing.*
Brooklyn Rapid Transit	48⅝
Consolidated Gas	192⅞
General Electric	155
Kings County Electric	187
Manhattan Elevated	148½
Metropolitan Street Railway	107½
New York & New Jersey Telephone	144
Westinghouse Manufacturing Company	175

The reports of the New York City Railway Company and the Third Avenue Railroad Company for the quarter ended March 31, 1904, show as follows: New York City Railway Company—gross earnings from operation, $3,262,845; operating expenses, $2,052,466, leaving net earnings of $1,210,379; other income, $190,615, bringing the gross earnings from all sources up to $1,400,944, as compared with $1,889,000 for the corresponding quarter of 1903. Third Avenue Railroad Company—gross earnings from operation, $475,992; operating expenses, $224,934; net earnings, $251,058; other income, $200,189, making the gross income from all sources $451,247, against $293,296 for the same period last year. The decrease in the net earnings of the Metropolitan system is attributed by President Vreeland to the unfavorable weather conditions generally, and also to the fact that sixty per cent more accident cases (principally for accidents which occurred more than three years ago) were disposed of than during the corresponding quarter of the previous year. The first quarterly rental dividend of 1¼ per cent on Third Avenue Railroad will be paid by the New York City Railway Company July 30. Books close July 13.

The directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 2½ per cent upon the preferred and the assenting and the non-assenting stocks of the company, payable July 11.

Boston:	*Closing.*
American Telephone and Telegraph	130¼
Edison Electric Illuminating	238
Massachusetts Electric	72½
New England Telephone	121
Western Telephone and Telegraph preferred	80
Philadelphia:	*Closing.*
Electric Company of America	9⅛
Electric Storage Battery common	55
Electric Storage Battery preferred	55
Philadelphia Electric	6
Union Traction	51½
United Gas Improvement	84
Chicago:	*Closing.*
Chicago Telephone	122½
Chicago Edison Light	142
Metropolitan Elevated preferred	52½
National Carbon common	29
National Carbon preferred	100
Union Traction common	5
Union Traction preferred	27

The regular quarterly dividend of 2½ per cent on the stock of the Chicago Telephone Company was payable June 30.

ELECTRIC LIGHTING.

DUNDEE, ILL.—Arrangements have been made by the Dundee Citizens' Light and Power Company to furnish street lights for the west side of the city.

MINNEAPOLIS, MINN.—It is reported that an electric plant may be established between Courtenay and Wimbledon, to furnish light to both towns.

AMHERST, N. H.—Arrangements have been made whereby current will be transmitted from the electric plant at Milford for lighting the village streets.

LONG BRANCH, N. J.—A five-year contract has been given by Belmar's council to the Atlantic Coast Electric Light Company at $85 a year for each arc light.

MYSTIC, CT.—The Westerly Gas and Electric Company, of Westerly, R. I., has acquired the Mystic Electric Light Company and the South Shore Electric Light Company, of Mystic.

OSHKOSH, WIS.—The Central Construction Company has secured the contract for installing electric lights at Kilbourn City, valued at $8,644. Twenty-eight lights will be used.

ROCHESTER, N. Y.—A certificate of the merger of the Municipal Gas and Electric Company with the Rochester Gas and Electric Company has been filed with the secretary of state at Albany.

WASHINGTON, D. C.—A steam turbine is to be installed in the plant of the United States Electric Lighting Company at 14th and B streets, which will add materially to the resources of the station.

BATESBURG, S. C.—An election held for the purpose of deciding the question of bonding the town for $20,000, with which to establish an electric lighting plant, resulted in a vote of seventy-five for and eighteen against the proposition.

NORFOLK, CT.—The amount of $10,000, which was to be raised by the Norfolk people in order to reorganize the Norfolk Electric Light and Power Company, has been secured, and the new company will be organized at an early date.

COLUMBIA, TENN.—It is announced that new machinery will be installed at the plant of the Columbia Water and Light Company, so as to permit of its being operated during the day. The plant is owned by Mr. Charles E. Bigelow, of New York city.

CHILLIWACK, BRITISH COLUMBIA—The Chilliwack Electric Light and Power Company has applied to the council for permission to install an electric light system in the town, and also for permission to build street car lines throughout the municipality.

NEW RICHMOND, WIS.—Active operations have begun on the second electric power transmission plant of the Apple River Power Company near Somerset. When this plant is completed, the company, which now lights New Richmond, will also furnish power and light for Stillwater.

ANN ARBOR, MICH.—The Michigan Milling Company has let the contract for a building 45 by 70 feet to be constructed at the site of the burned Argo mills, which will be used as a power plant to generate electricity to run its other two mills in the city. The new plant will be finished in sixty days.

WATKINS, N. Y.—The board of water and sewer commissioners of the village of Watkins, N. Y., offer for sale not to exceed $20,000 bonds of said village, authorized in April last for the installation of a municipal lighting plant. Proposals addressed to C. M. Woodward, secretary, Watkins, N. Y., will be received until July 20, 1904.

LOUISVILLE, KY.—The American Electric Lighting Company has filed articles of incorporation with a capital stock of $10,000. The company is to light the new city of Oakdale, which lies south of Louisville. The incorporators are as follows: Chas. A. Hess, Mary Rosenfield, Louis F. Otis, Thomas F. Condon. The corporation is to have a life of twenty-five years and a maximum indebtedness of $5,000.

BOONEVILLE, MISS.—At a meeting of business men held recently a stock company was organized and stock subscribed for the erection of an up-to-date light plant and telephone system. Booneville is without lights now, and the new light plant will be put in operation at once. The town has granted a franchise, and application will be made for a charter.

WILKESBARRE, PA.—At the annual meeting of the stockholders of the People's Light Company, of Pittston, the following directors were elected: Liddon Flick, R. J. Flick, C. O. Perkins, W. I. Hibbs and J. N. Thompson. On the organization of the board the following officers were elected: president, Liddon Flick; vice-president, J. N. Thompson; secretary and treasurer, R. J. Flick.

WARREN, OHIO—The village council of Newton Falls has awarded a ten-year contract for lighting that village with electricity to E. E. Mandeville, of Philadelphia. He is to build and equip the plant and system, and furnish sixteen arc lights at $70 per lamp. A twenty-year franchise for commercial lighting and furnishing power also went with the contract. The service is to begin within three months.

LA GRANDE, ORE.—The company that has bought out the La Grande Light and Power Company plant will within the next eighteen months make an addition of 150 horse-power to the plant and reconstruct it entirely, putting $16,000 into improvements. The plant was recently sold to J. A. Thronson & Bros., of Dayton, Wash., to be known as the Thronson Stock and Power Company. The consideration was $40,000.

BURLINGTON, VT.—An extensive water power, developed in Middlesex by G. E. Moody, of Waterbury, and G. H. Almon, of Montpelier, is nearly ready for use. They constructed a dam 150 feet long across the Mad river, thereby giving them a pond one mile long and 300 feet wide. Men are now at work building the powerhouse, which will soon be completed. The power for lighting the village of Northfield will be taken from this source as well as power for the extensive granite industries in that village.

MINEOLA, L. I.—A franchise for fifty years has been granted to the Queens Borough Gas and Electric Company, of Far Rockaway, by the Nassau supervisors, to lay mains, erect poles and string wires under and over county roads in the town of Hempstead, for the purpose of furnishing gas and electricity to the people for light, heat and power. The company is required to give a bond for $2,000 and pay an inspector $3 daily to see that the highways are properly replaced after being disturbed in performance of the work.

CAMBRIDGE, NEB.—The Cambridge electric light plant, which has been operated under the management of P. B. Cole, has been organized into a corporation under the name of the Cambridge Electric Light Company, with an authorized capital of $10,000. The articles of incorporation include the maintenance of a heating plant and a system of waterworks, which will be put into effect later. At a meeting of the stockholders the following board of directors was elected: W. H. Faling, J. H. Rosenfelt, E. C. Rodwell, George Williams and D. F. Neiswanger.

AUTOMOBILE NOTE.

THE AUTOMOBILE RUN TO ST. LOUIS—The touring committee of the American Automobile Association, having in charge the run to St. Louis, July 25 to August 10, 1904, is now able to announce that at practically all night stops more than ample accommodations have been secured for man and machine, and at over half the noon stops the luncheon arrangements have been settled. In nearly all cases covered garages are available. In the few instances where storage will have to be in the open air the committee has obtained the use of enclosed yards, where the machines will be under the eyes of watchmen during the night. At all night stops the committee is arranging for adequate supplies of gasoline, in several cases tank wagons being contracted for to be on hand at the garages. President Francis, of the St. Louis World's Fair, has issued a permit for the parade to enter the exposition grounds. The suggested line of march at St. Louis submitted by the St. Louis committee is as follows: On the morning of August 11 all machines will meet at Twelfth and Pine streets, and proceed west on Pine street to Grand avenue, north on Grand avenue to Lindell avenue, and straight out Lindell avenue to the exposition grounds. From there the line of march will be through the grounds and out one of the gates, entering Forest Park, where the tour will disband and refreshments will be served. The St. Louis Automobile Club has tendered the use of its new club-house and grounds to the tourists on August 10 and during the days while the tourists are in the city.

ELECTRIC RAILWAYS.

OSKALOOSA, LA.—The Mahaska Construction Company has been formed to build an electric line to Beacon and Buxton.

CRESTON, IOWA—A company has been formed to build an electric interurban line to Des Moines. Richard Brown, of Creston, is secretary.

SHARON, PA.—Civil engineers are at work making a general survey of the proposed new trolley line between New Wilmington and Sharon.

EVANSVILLE, IND.—The town of Rockport has granted a franchise to the Evansville & Rockport Traction Company for a term of fifty years. Work must be begun within a year.

BALTIMORE, MD.—The Middletown & Cecilton Railroad Company has been granted a franchise for a trolley line between Middletown, Delaware, and Fredericktown, on the Sassafras river.

HARTFORD, CT.—A financial statement issued by the Connecticut Railway and Lighting Company shows earnings of $354,981.78 for the first four months of this year, as against $282,968.60 for the same months in 1903.

BUTLER, PA.—A syndicate has a local real estate firm at work taking rights of way for a trolley line from Butler to Kittanning. The line passes through East Butler, and thence is to parallel the Kittanning pike through Coylesville and Worthington.

NEW HAVEN, CT.—The Consolidated Railway Company, through its Fair Haven and Westville branch, has begun the construction of the connecting link between the Fair Haven and the Wallingford trolley roads. The road will be completed in September.

SPRINGFIELD, OHIO—The Springfield & Xenia Railway Company has been incorporated with a capital of $100,000, by Harrison B. McGrew, J. W. Van Dewees, A. T. Hills, G. D. Reed and N. Haas. The company will acquire the Springfield & Xenia line, now in operation.

CARTHAGE, MO.—The Western Traction Company, which purposes to build an electric line from Carthage to Springfield, has awarded the contract for construction work to the Farnham Construction Company, Chicago. The securing of the right of way will begin as soon as the route has been surveyed.

SAN JOSE, CAL.—The Interurban Electric Road is extending its line from Saratoga to Congress Springs and cars will be running to that point within a few weeks. With the completion of the road to Congress Springs the rolling stock will be largely added to and a fast passenger service will be installed.

SPOKANE, WASH.—It is reported that a project is now on foot to build an electric railway from Hedley, British Columbia, to Curlew, on the Spokane Falls & Northern Railroad. J. M. Hagerty of the Similkameen Falls Power and Development Company is said to be making negotiations for the construction of the road.

WHEELING, W. VA.—The Steubenville, Mingo & Ohio Valley Traction Company has been granted a franchise by the Jefferson county commissioners to construct a line along the pike between Steubensville and Mingo. The new line will follow the river and will shorten the distance between the two towns by several miles.

WINCHESTER, VA.—A company to build an electric railroad from a point just outside of Washington, *via* Bluemont, to Winchester has been formed here. S. H. Hansbrough is president; Shirley Carter, secretary, and S. L. Hoover, manager. The building of the new road is contemplated to take place as soon as the franchise is secured.

ELIZABETH, N. J.—The Morris County Traction Company has secured a right of way through Union township, and will soon start work on its line from Springfield to Summit. The road will also connect the following places: Chatham, Madison, Morristown, Denville, Dover and Lake Hopatcong, with branches to Paterson, Boonton and Bernardsville.

NEW YORK, N. Y.—The contract for the building and installation of the first electro-magnetic railroad to come into existence has been awarded. The road, which is of the elevated type, is to run from South Beach, S. I., to a point near Midland Beach, and will be about two miles in length. Professor A. C. Albertson is the inventor of the system.

JEFFERSON, OHIO—The Warren, Cortland & Jefferson Traction Company has been granted a franchise by the county commissioners to build and maintain an electric road from the north line of Trumbull County, in Colebrook, north to Miller's Corners, in New Lyme Center, and thence north to the south line of Jefferson village. The road is to be completed by 1906.

BAY CITY, MICH.—The promoters of the Saginaw Southern Railway Company, which has a franchise to build an electric line from Saginaw to Owosso, state that the project has been financed and that the work of construction will begin shortly. The company will also build a line from Saginaw to Caro, and from Bay City to Saginaw, with a branch to Vassar.

MUNCIE, IND.—The construction work on the Muncie & Dayton traction line has been completed to a point three miles east of here, and there is no doubt that the road will be built into this city before the end of summer. The road is now in operation between Dayton and Greenfield, Ohio. The power station is at Winchester and the several substations are about finished.

BOSTON, MASS.—The receivers of the Lowell & Boston Street Railway, operating nine miles of track between Woburn and Billerica, have resumed operation of the property. It is understood they will ask the Woburn city council to renew the location for a line in the westerly part of the city, granted the old management of the road, it having expired by limitation July 1.

BELMAR, N. J.—The work of laying the trolley tracks to connect Belmar with Spring Lake has been begun. When completed, this line will form a circuit from Trenton to Lakewood and Point Pleasant, along the shore, taking in Manasquan, Sea Girt, Spring Lake, Como, Belmar, Avon, Asbury Park, Long Branch and all the shore-lying district, to Atlantic Highlands and Keyport, and across country to Trenton.

NORRISTOWN, PA.—The Souderton, Skippack & Trooper Railway Company has increased its capital stock from $100,000 to $200,000, and the directors were authorized to bond the road for $170,000 or at the rate of $10,000 a mile. The company has about twenty-five yards of track laid in Worcester township, but was halted by the township authorities, who contended the company was not in a position to construct and equip the road.

MINEOLA, N. Y.—The project of a trolley to connect the villages along the north shore of Long Island with the county seat of Nassau County is again being revived. It is stated that much of the right of way has been secured, and that there is ample capital behind the plan. The road, as proposed, will run from Huntington, to and through East Norwich, Oyster Bay, Locust Valley, Glen Cove, Sea Cliff, and thence to Roslyn, and along the Roslyn and Mineola road to the county seat.

WASHINGTON, PA.—The Washington County Street Railway Company, headed by former State Senator William Flinn and other Pittsburg capitalists, recently granted franchises in Washington, is making active preparations to commence work on the construction of a line from Washington to Pittsburg. The route through East Washington has been refused, and the line from Washington will connect with the Pittsburg & Charleroi line at Library, instead of at Finleyville, as contemplated. Engineers are now making surveys. The line, it is estimated, will be constructed for $700,000.

STOCKTON, CAL.—Four franchises for suburban electric lines have been granted to H. H. Griffiths by the board of supervisors. They will connect with the new electric street railway system, which Mr. Griffiths will construct in Stockton. He had already secured franchise for lines in all parts of Stockton. One of the roads in the county will run from the city limits out the old French Camp toll road and back to the city limits. Another line will run out one and one-half miles through the Fair Oaks addition. The third route will run over the lower Sacramento road to Calaveras river and the fourth out by way of the Cherokee Lane.

INDUSTRIAL ITEMS.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., illustrates and describes in its bulletin No. 3053 the "Emerson" laboratory motor-lathe for alternating current.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 19-21 Park Row, New York city, will mail on request its new price list of "flexduct." This price list also contains some interesting data concerning the use of "flexduct" for insulating purposes.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., reports large sales of its weather-proof iron-box telephone, which is designed especially for mine, street railway and police systems. The company will send its large new catalogue, which is profusely illustrated with telephone material, on request.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., in bulletin No. 350 describes and illustrates stationary and portable motor-driven air compressors for continuous and intermittent service. In addition to the general description, several views are shown of these air compressors, giving a detailed idea of their mechanism and operation.

THE ABNER DOBLE COMPANY, San Francisco, Cal., is distributing its catalogue treating on tangential water wheels. This catalogue contains illustrations and descriptive matter, together with much valuable hydrostatic information in connection with the tangential ellipsoidal water wheels which the company makes. Catalogue will be sent on request.

THE L. B. ALLEN COMPANY, INC., Chicago, Ill., states that it received the following letter under date of June 17, 1904, which may be of interest to many. "Among other items, we want to bid to the Washington Navy Yard on Tuesday next, on soldering sticks. We wrote the storekeeper asking whose make was satisfactory, and he said, the 'Allen.'"

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has published a large wall map of the "S. K. C." system of long-distance transmission in California. This is a most valuable and interesting contribution to contemporary engineering data. The map is of great size and the indications are clear and distinctive. The work has been produced by the office of Mr. Ray D. Lillibridge, New York city.

THE CHICAGO & NORTHWESTERN RAILWAY COMPANY, through its passenger department, has published a note on the opening of the Rosebud reservation land. This sets forth the rules for land seekers, the requirements of the Government, what the applicant must do to secure a quarter section, the time, place and manner of allotment, and who is entitled to the lands. Mr. W. B. Kniskern is the passenger traffic manager, Chicago, Ill.

THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ontario, reports that it has recently closed a contract to furnish the Shawinigan Water and Power Company, Shawinigan Falls, Province of Quebec, with a 6,600-kilowatt, two-phase, 2,200-volt, 3,600 alternations, 180 revolutions per minute rotating field alternator, for direct connection to a water-wheel, and two 2,200-kilowatt, oil-insulated, water-cooled transformers, 2,200-volt primary and 50,000-volt secondary.

THE CHARLES WARNER COMPANY, Wilmington, Del., and Philadelphia, Pa., sales agent for "Nazareth" portland cement, is distributing an interesting catalogue, which contains a list of important operations on which "Nazareth" portland cement has been used. A number of illustrations show typical instances where this product forms an important part of the structural work. The catalogue also contains tables and curve sheets showing some tests made. Catalogue will be sent on request.

THE NATIONAL CONDUIT AND CABLE COMPANY, 41 Park Row, New York city, manufacturer of bare copper wire, weather-proof wires and cables, lead-covered wires and cables, for telephone, telegraph, light and power work, issue regularly a bulletin entitled "Copper Gossip." This gives a number of points on the general business outlook, the copper market situation, the London copper market, New York and London copper markets, exports and imports of copper, 1904, copper mining news and developments, and European copper statistics.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., states that it has been awarded contracts to install its automatic telephone system in the cities of Battle Creek, Mich., and Van Wert, Ohio, replacing manual systems previously installed. The Citizens' Telephone Company, of Grand Rapids, Mich., who replaced its manual exchange in that city with the automatic exchange last winter, is the owner of the Battle Creek system, and the Van Wert Telephone Company is the owner of the Van Wert system. The new automatic exchange at Battle Creek is to have a present installation of 1,000 instruments, with an ultimate capacity of 10,000. The Van Wert exchange is to have an installation of 925 instruments, with an ultimate capacity of 10,000.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., makes the following announcement: The equipment of factories with electric motors for individual and group drive of machine tools has become such an extensive department of its business that it is warranted in going a step further. It is now prepared to give its clients expert advice upon the latest ideas and results in shop practice, in addition to purely engineering advice upon the design and installation of electrical apparatus for shop equipment, which it has been giving for a number of years, and for which it now enjoys a considerable reputation. To this end it has retained the well-known firm of Dodge & Day, modernizing engineers, of Philadelphia, Pa. It places the services of this firm at the disposal of its customers, giving them gratuitously the benefit of its wide experience and data. The advice and recommendations about which its customers may consult this firm need not be confined to electrical details, but may include all problems of shop equipment and management.

THE WESTINGHOUSE COMPANIES AT THE LOUISIANA PURCHASE EXPOSITION, the title of the united Westinghouse companies exhibiting at St. Louis, will show at the private Westinghouse auditorium a most modern collection of moving pictures. Quite recently these pictures were shown at Carnegie Hall, Pittsburg, 2,500 Westinghouse employés attending. The pictures are of scenes within and without several of the Westinghouse manufactories, scenes along the Pennsylvania Railroad, and interiors showing shop practice. These pictures attest the great value of the Cooper Hewitt lamp in making interior exposures for a mutoscope reproduction. The camera was placed about fifteen feet above the ground, on a platform suspended from an electric traveling crane, and moved slowly down along the aisle about fifty feet in the rear of the Cooper Hewitt lamps, the latter also suspended from a traveling crane moving at an equal speed. So far as possible in the taking of these mutoscope pictures, any sunlight through the glass skylights of the shop was taken advantage of. On the first crane, with the lamps, was mounted a 500-volt motor connected to a twenty-seven-kilowatt generator of 125 volts, direct current. The sixty-four lamp tubes themselves were hung in sets of eight, in eight frames, each about five feet high, three feet wide, and four inches deep, and fitted with resistance coils, each board taking thirty-five amperes at 110 volts, the entire set of lamps requiring only from thirty to forty kilowatts.

RECEIVERSHIP NOTE.

RECEIVER APPOINTED FOR ORANGE COUNTY GAS AND ELECTRIC COMPANY—The Orange County Gas and Electric Company, of Middletown, N. Y., has been put into the hands of a receiver by Judge Blanchard of the Supreme Court, who appointed George A. Swayze, of Middletown, on the application of Henry Floy, president of the company and owner of $110,000 of its stock, who claims $10,766 for salary and money advanced. There are two mortgages on the property to secure bonds of $214,000. The company has a capital of $300,000, of which $200,000 is outstanding.

OBITUARY NOTICES.

MR. J. J. WALSH died recently at his home at No. 6 East Ninety-third street, New York city, N. Y. Mr. Walsh was treasurer of the Stock Quotation Telegraph Company. He was sixty-two years old and died from heart failure. His wife and one son survive him.

MR. CHARLES M. STEBBINS died in Berlin, Germany, on June 16, 1904. He was born in Chardon, Ohio, on March 11, 1829. In 1858 he purchased the St. Louis and Missouri river telegraph line, which later became the Missouri and Western Telegraph Company. In anticipation of a congressional grant for a telegraph line across the continent, he constructed lines along both the overland routes from St. Louis to Fort Smith, Arkansas, and from St. Louis to Julesburg, Nebraska Territory. He later sold these lines to the Western Union Telegraph Company. Mr. Stebbins was a close friend of Mr. Robert C. Clowry, the present head of the Western Union Telegraph Company. Of late years Mr. Stebbins has lived in Europe.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JUNE 21, 1904.

762,881 X-ray apparatus; W. B. Churcher, Cincinnati, Ohio.

762,882 Secondary battery; J. P. Clare, Quincy, Mass.

762,927 Composite incandescent-lamp bulb and reflector; O. A. Mygatt, New York, N. Y.

762,957 Partial circuit for electric currents; G. Thompson, Duluth, Minn.

762,988 Electrical driver for centrifugals; W. L. D'Olier, Philadelphia, Pa.

762,993 Circuit interrupter for jump-spark coils; C. H. Fischer, Cincinnati, Ohio.

762,997 Railway-switch-operating apparatus; M. D. Hanlon, Wilkinsburg, Pa.—An apparatus for moving railway switches, comprising a motor, a cam-cylinder for moving the switch-rails and an electric clutch intermediate the motor and cam-cylinder.

763,002 Electric-lighting apparatus; W. Knoblich, New York, N. Y.—Consists of a base or support of non-conducting material having metallic

(Continued on page 44.)

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PATENTS.

(Continued from page 43.)

sockets therein adapted to receive glower-terminals and an electric heater embedded in the same.

763,009 Guard for incandescent lamps; J. W. Matthews, Bridgeport, Ct.

763,011 Signaling device for pasteboard-making machines; O. Mietasch, Gorlitz, Germany.

763,016 Ball-bearing trolley-wheel; J. A. Norton, Wilkesbarre, Pa.

763,031 Electric-motor controller; W. N. Vance, Chicago, Ill.

763,042 Fire-alarm apparatus; L. Campbell, Washington, D. C.

763,054 Gas-regulator; G. T. Gamble, Grand Rapids, Mich.

763,071 Motor-control system; C. L. Perry, Schenectady, N. Y.

763,082 Telegraph-transmitter; J. F. X. Trotier, Montreal, Canada.

763,093 Telephone directory; F. Drowns, Malden, Mass.

763,108 Electric brake; F. C. Newell, Wilkinsburg, Pa.

763,129 Combined guard and stand for electric lamps; J. C. Tudor, Baltimore, Md.

763,151 Process of electrically extracting essential oil; G. D. Burton, Boston, Mass.

763,152 Process of making extracts by electricity; G. D. Burton, Boston, Mass.

763,164 Apparatus for determining the length of waves and observing the oscillations in electric oscillation systems.

763,168 Current regulator; J. B. Entz, Philadelphia, Pa.

763,183 Ultro-violet-ray electrode; C. F. W. Horn, New York, N. Y.

763,223 Safety device for strong-

(Continued on page 46.)

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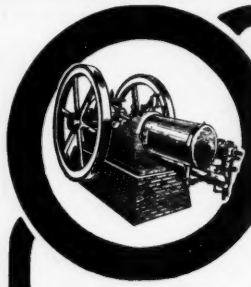
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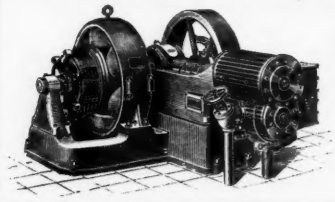
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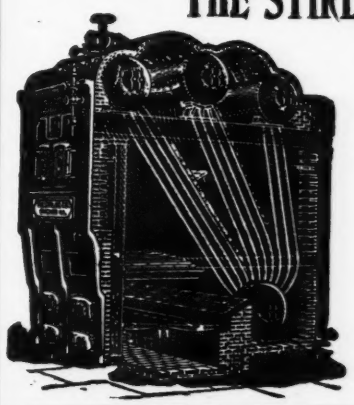

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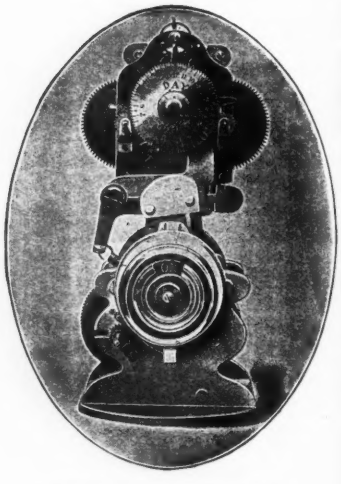

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NOTICE is hereby given that sealed proposals will be received by the Light and Water Committee of Councils of the City of Williamsport, Pennsylvania, till 12 o'clock noon of Friday, July 29, A. D., 1904, for lighting the streets of Williamsport, Pennsylvania, with the most modern system of Electric Lighting, every night and all night for a period of five years, also for a period of ten years, from December 1, 1904; also bids for lighting the City Hall and the several Fire Engine Houses of the City for similar periods. Bids for street lighting to state the kind and number of lights to be furnished, the system of lighting, the candle power and distribution of lights. Bids to be accompanied by a certified check in the sum of five thousand dollars ($5,000.00), upon one of the banks of the City of Williamsport, said amount to be forfeited as liquidated damages in case the successful bidder fails to execute contract and furnish required bond. The City reserves the right to reject any or all bids. Bids are to be sent to the City Clerk endorsed "PROPOSALS FOR ELECTRIC LIGHTING." The successful bidder shall have the privilege of erecting poles, wires, etc., for the purpose of furnishing lights for the streets of the City, the Fire Engine Houses and City Hall, as well as for commercial purposes, under such regulations as Councils may by ordinance provide. All information in regard to number of lights, location of same, etc., can be obtained of the City Clerk, Williamsport, Pa.

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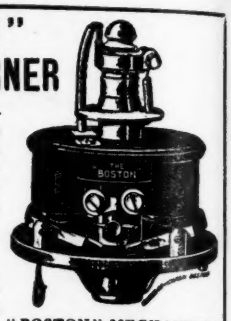

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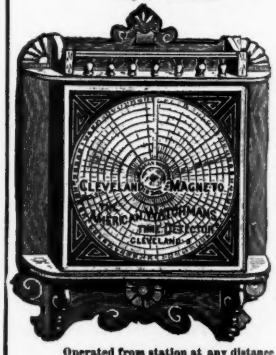

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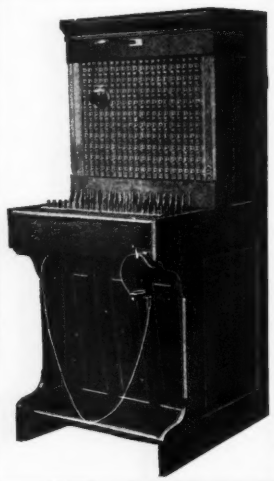

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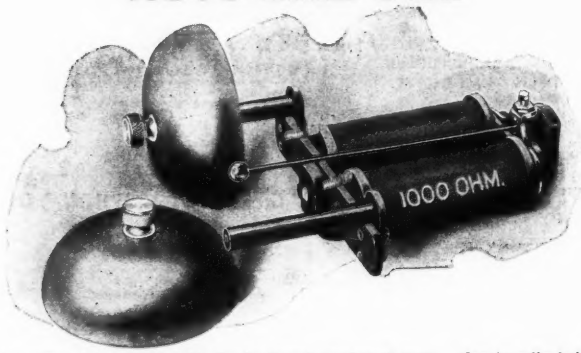

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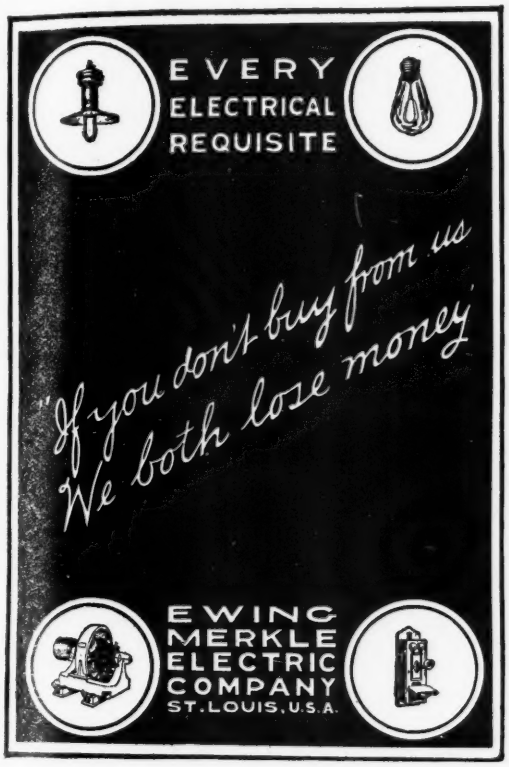

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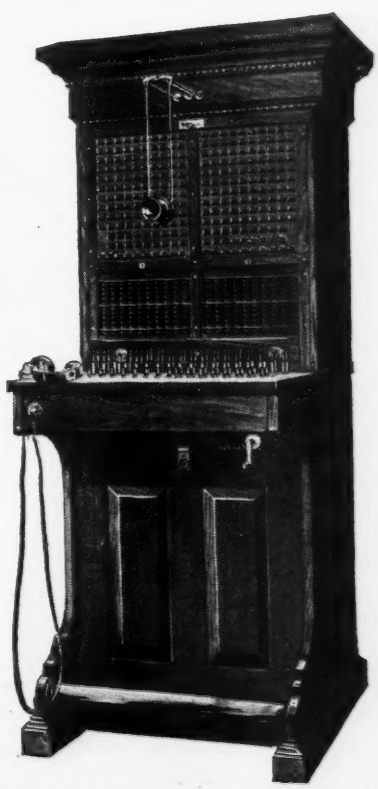

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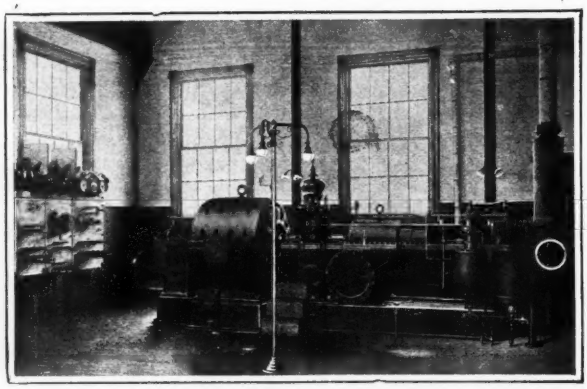

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